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Economic and Policy Implications of the 160-Acre Limitation in Federal Reclamation Law

David Seckler and Robert A. Young

Proposals for strict enforcement and, conversely, for relaxation or elimination of acreage limitations in federal irrigation projects have arisen in response to recent court decisions regarding two large California irrigation districts. These proposals are examined against criteria including distributive justice, allocative efficiency, and administrative workability. Empirical evidence is offered which shows that proposed regulations would permit overly generous family incomes in the two areas and brings into question the existence of significant economies associated with larger size farms. An alternative policy instrument, based on control of the water supply, rather than of the land, is proposed so as to reconcile more effectively conflicting policy objectives.

Key words: acreage limitation, economies of size, irrigation policy.

The Reclamation Act of 1902 opened the door to three-quarters of a century of subsidized agricultural development in the West through provision of inexpensive irrigation water. While it is perhaps impossible to determine exactly how much the total subsidy of federal water projects has been to date, certainly it is in the billions. The number of farms directly benefited has been barely more than one hundred fifty thousand. The per farmer stakes can be high indeed. As will be shown subsequently, even a modest farm operation of 160 acres in California may receive a subsidy on water costs, the capitalized value of which is in excess of $100,000.

In an attempt to assure widespread distribution of program impacts, the 1902 Reclamation Act contained the following provision:

> No right to the use of water for land and private ownership shall be sold for a tract exceeding 160 acres to any one individual landowner, and no such sale shall be made to any landowner unless he be an actual bonafide resident on the land, or occupant thereof residing in the neighborhood.

There are few, if any, examples in American jurisprudence where the gap between *de jure* and *de facto* looms so large. The 160-acre limitation can be subject to administrative interpretations. For example, the U.S. Department of Interior is now proposing to interpret this as 640 acres of owned, together with 320 acres of leased, land for a total 960-acre limitation. Such a "family farm" in the Westlands District of California would operate about $1.5 million worth of land, with about $200,000 worth of machinery. Their net annual income would average more than $100,000, of which about $36,000 is due to the difference between the subsidized value of federal water and the price of state water supplies.

The controversy over the 160-acre limitation is essentially a controversy over the distribution of this subsidy. The parties to the conflict represent two fairly distinct pecuniary and ideological positions. Opponents of the limitation are mainly those farmers now benefiting from nonenforcement of the limitation who demand the entrepreneurial freedom to acquire as much land and water (and subsidy) as their efforts and ingenuity permit, within the limits and rules of the "free enterprise

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Editor's note: This article was invited by the editor.

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The authors wish to thank John R. McKean for advice and for performing computations and Charles V. Moore for criticism of an earlier draft and assistance in securing and interpreting data. Several anonymous referees were helpful, as well as were participants in a seminar at the University of California, Berkeley. Warren Johnston and Harold Carter were helpful in finding some of the data used here. Support of Colorado State University Experiment Station is acknowledged. Of course, the authors alone bear full responsibility for the views expressed herein.

system." They further argue that larger farms are essential for economic viability and to low-cost food production. Proponents of rigorous enforcement of the limitation advocate a more widespread distribution of the opportunities provided by the reclamation program, and expect also the creation of a more desirable "rural community." Neither side, to our knowledge, advocates reducing the amount of the subsidy.

The values underlying these conflicting ideologies emphasize, in John Brewster's terms, the "Enterprise Creed" versus the ideal of "distributive justice." The enterprise creed is distinguished by a belief in capital accumulation as the test of virtue. The ethics of distributive justice holds that society is obligated to provide all its members with opportunity or access to the means necessary for developing their potential to the fullest extent possible.

For our part we write from a perspective distinct from either of the above positions. We perceive no reason to subsidize any individual or group unless there is good reason to believe that the subsidy creates external benefits, or offsets external costs, or provides collective goods that would otherwise not be forthcoming. Among these collective goods we would include help to the weak and the poor. Applying these criteria, we find that there is no compelling rationale for anything like the amount of subsidies now being provided under federal water programs. Nor do we find the "efficiency" arguments of the opponents to limitation; nor the "family farm" ideology of many of the proponents of the limitation, persuasive.

But while there is nothing so enjoyable, nor so necessary in policy analysis, as a quarrel over values, that quarrel is not our central objective here. Before policy recommendations can be intelligently formulated, a background of more objective facts and theories must first be established. It is our central objective to contribute to the formulation of that background. The following does not pretend to be a *Wirtfrie* tract—a policy analysis (unlike an "economic" analysis) does not need to pretend to be so; rather, it is presented as a marshalling of such facts and theories as we consider relevant around the values expressed in the preceding paragraph.

The remainder of the paper is organized as follows: after a brief historical survey of the controversy over the limitation, the discussion attempts to review the present status of federal water programs with respect to the acreage limitation, with particular reference to the Westlands and Imperial Water Districts in California. Estimates of the amounts and distribution of the subsidy are presented and the impacts of the limitation in this agricultural situation are analyzed. With this background established, we turn to one of the more important and complex elements of the controversy—the question of economies of size to provide a basis for some alternative lines of research in the future. Last, we attempt to generate alternative policy instruments commensurate with the discussion of the preceding sections. The conclusions are that (*a*) the amount of the subsidy should be reduced, (*b*) there are better ways to distribute whatever subsidy remains than through the acreage limitation, but, (*c*) these better ways may not be legally or politically feasible, and (*d*) if so, then rigorous enforcement of the limitation in the range of 160–320 acres of owned and/or leased land per operating family unit, depending on particular project areas, is indicated.

The Historical Evolution of the Limitation

The United States government has, historically, pursued policies which increase the productive capacity of the agricultural sector in order to assure adequate food supply for consumers, to improve the economic well-being of the rural population, and to settle and secure new territories. In accordance with the Jeffersonian vision of a nation of small, independent landowners, the first major tool of agricultural development policy was the distribution of publicly owned lands to potential settlers at nominal prices. The general policy of encouraging family farms was continued with the Homestead Act of 1862, which offered 160 acres of land free to those who would live on it for five years. As the tide of settlement flowed westward throughout the nineteenth century, it was found that crop production in the arid and semiarid west was largely dependent on irrigation water.

Federal support of private irrigation development came with the Confirmation of Western Water Rights Act (1866), the Desert Land Act (1877), and the Carey Act of 1894. By the end of the century, almost four million acres had been placed under irrigation. However, most of the normal irrigation season flows were being utilized, so further development would require larger capital investments for dams and reservoirs to store spring season runoff, and proposals for federal action in this field became frequent.

Direct federal participation in arid land reclamation came in 1902 with the adoption of the Reclamation Act. The sale of public lands was to provide a revolving fund to be used for the construction of major irrigation facilities. Settlers were to receive land without cost, but were to repay, without interest on the capital, the public investment in the irrigation structures. Capital and expertise were provided for water projects on a scale larger than could be afforded by private interests or local communities. Later amendments converted the repayment procedure to an "ability to pay" principle, in effect, separating repayment requirements for irrigation water from the true costs of the water while continuing the interest-free provision. Current projects are subsidized to the extent of over 80% of costs. That is, water recipients are obligated for less than 20% of the investment in structures and conveyance systems, including imputed interest on that investment over the normal repayment period (North and Neely). This degree of federal cost-sharing makes the program exceedingly attractive to potential water users and local and state governments in prospective project areas.

The Reclamation Act was formulated against a background of widespread abuses in administration of the Desert Land Act and other legislation which distributed the public domain. Great tracts of land were accumulated by absentee landowners who financed their employees in filing fraudulent claims and later obtained the land once the employee secured title (Hibbard, p. 429). The ensuing scandals provided the basis for a new political movement which advocated a land policy that favored small, family farms.

In the Reclamation Act, the 160-acreage limitation was supplemented with a residency requirement and with antispeculation rules. The latter required that owners of land in excess of 160 acres must sell it at a pre-project price, so as to prevent the original large owner from reaping the capitalized value of the federal subsidy to the detriment of the intended recipients of the subsidy.[2] Thus, the "160-acre limitation" provisions represent not just a limit on land, but includes several other constraints aimed at ensuring that small, family farms would be the outcome of the federal program.

The acreage limitation law from the beginning has been perhaps the most controversial aspect of the reclamation program, and numerous attempts at repeal have been launched (Sax, p. 210). There are, no doubt, reasons to question a rule limiting for all times and all places the amount of land a farmer can utilize, in view of drastic changes in technology, scale of farm operations and relative prices during the ensuing three-quarters of a century, and conditions of production that vary among different projects. However, most of the dispute has been on ideological grounds. Both proponents and opponents have assumed a stance of moral righteousness and ominously have warned that if their lead is not followed even revolution may ensue. Theodore Roosevelt set the tone in a rather heroic address in defense of the limitation before the Commonwealth Club of San Francisco in 1912.

> I wish to save the very wealthy men of this country and their advocates and upholders from the ruin that they would bring upon themselves if they were permitted to have their way. It is because I am against revolution; it is because I am against the doctrine of the Extremists, of the Socialists; it is because I wish to secure this country against ever seeing a time when the "have-nots" shall rise against the "haves"; it is because I wish to secure for our children and our grandchildren and for their children's children the same freedom of opportunity, the same peace and order and justice that we have had in the past (Taylor, p. 262).

Roosevelt's threat of revolution from the Left was taken up by a senior vice president of the Bank of America as late as 1969 who contemplated a revolution from the Right (or, at least the West). Of the 160-Acre Law, he said, it is a "ridiculous law, fostered by provincialism and Eastern political jealousy, . . . subjugating economic realism to petty political tyranny. . . ." And, he added, "maybe this is what causes the seeds of a civil war" (Taylor, p. 253).

Both sides, for all their revolutionary ardor, have approached the subject with some caution. There is always the danger, when quarreling over the distribution of public subsidies, that the attention of those taxpayers who do not receive the subsidies will be aroused and the subsidies may be withdrawn altogether. The point was eloquently put by congressman Claire Engle in testimony before a House subcommittee,

> I grant you, you start kicking the 160 Acre Limitation and it is like inspecting the rear end of a mule: you want to do it from a safe distance because you might get kicked through the side of the barn. But it can be done with circumspection, and I hope we can exercise circumspection (Taylor, p. 253).

In the half-century since the publication of the original law, the Department of Interior has relied only to a limited extent upon formal, written rules and regulations for the interpretation and enforcement of this document. Rather, it has been handled in the fashion of English common law, and interpreted, basically, as a "Dead Letter" law. That is to say, the interpretation and the enforcement of the law has been at the convenience of administrative bodies depending upon the nature of the particular situation in which it is to be applied. By this means, as the British have long understood, the law is at the discretion of the administration. On the whole, as Sax (p. 213) observes, "interpretation and enforcement of the excess land law was less than vigorous." Thus, as various administrations and various courts have had the law before their attention, the countryside has become agitated.

The level of conflict has intensified in the last few years as a populist administration has come into conjunction with strict constructionist courts. In August 1977, the federal circuit court in San Francisco ruled that the 160-acre limitation applied to the Imperial Irrigation District, California. That District, comprising some 445,000 irrigated acres located on the Mexican border in the Imperial Valley, had operated under a 1933 administrative ruling by the Secretary of the Interior which held that the acreage limitation did not apply to the District.

Previously, in August 1975, in response to a suit filed by *National Land for the People* challenging Bureau of Reclamation procedures employed in the disposal of excess lands in the Westlands Irrigation District in the San Joaquin Valley of central California, the court ruled that the U.S. Bureau of Reclamation shall "forthwith promulgate rules and regulations on procedures and criteria to be used in the approval of excess land" (Hinds, p. 3).

In compliance with that order, the U.S. Department of Interior published a rather striking set of proposed regulations. The following synopsis by Eugene Hinds, Chief of the Division of Water and Land of the U.S. Bureau of Reclamation, provides an indication both of what will be, if implemented, and also what historically has been.

First. In the past an individual's nonexcess acreage entitlement was determined on the basis of the irrigation district in which the land was allocated. In other words, the landowner was entitled to up to 160 acres in more than one district or contract service area. Under the proposed rules and regulations, an individual would be limited to only one nonexcess entitlement for all Reclamation projects.

Second. Under the proposed rules and regulations *residency* would be a requirement for a purchaser of excess land. A resident landowner is a person who has his or her principal place of residence on or in the neighborhood of the land receiving water. *Neighborhood* of the land is defined as an area within a radius of 50 miles from the land receiving water from the project.

Third. Under existing practices, multiple ownership arrangements are acceptable if a loose family relationship exists among all members who are a part of the multiple ownership arrangements, or where the effect of the multiple ownership is to break up large landholdings. The proposed rules would tighten these requirements by requiring that a multiple ownership arrangement in future purchases of excess land could only be used where a direct lineal family relationship exists among the members and the members qualify as eligible nonexcess owners. A direct lineal family relationship means parents, children, grandchildren, or grandparent relationships.

Fourth. Under current practice, there are no restrictions on leasing of land unless the lease arrangement continues or establishes in the lessee what would constitute an essence of ownership in the land leased. The proposed rules and regulations would change this procedure by first, prohibiting leasebacks of land by the purchaser of excess land to the seller of excess land, and second, by limiting the number of acres that an individual can lease to the same number of acres that he or she would be entitled to own or 160 acres.

Fifth. In the disposition of excess lands the procedure that has been followed is that the owner of the excess land retains the right to choose the buyer of his land. However, the seller and buyer are required to secure, from the Bureau of Reclamation, the approval of the price of the land to be sold and a determination that the buyer can qualify as an eligible nonexcess owner. The new rules and regulations will continue to follow this procedure but will require that the purchaser of excess land be chosen by lottery or other impartial means from those who qualify and express an interest in purchasing a particular parcel of land. A preference will be given to those in a family relationship with the seller. The proposed regulations also require that personal and nonfixture property be sold separately. The purchaser of land will not be required to buy any such items as a condition of the land sale.

Sixth. The current practice, insofar as recordable contracts are concerned, is that a 10-year period is provided for the owner of the excess land to dispose of his land. The term for most recordable contracts that are now in effect begins when the landowner signs the recordable contract. Under the proposed rules and regulations all new recordable contracts will have a disposition period of 5 years which will begin when the Secretary of the Interior determines that project water is available to a block of land.

Seventh. The new rules and regulations strengthen the procedures to be followed in controlling speculation in the purchase and resale of excess land. Currently, price approval is required only for the initial sale of excess land into nonexcess status. As nonexcess the land can be sold at market value. Under the proposed rules and regulations, approval for all resales of land purchased from excess status into nonexcess status will be required for a period of 10 years after the initial sale. After 10 years *and* until one-half the construction charges are paid, sales will be monitored to prevent unreasonable gains from any resale.

Last, in April 1978, the Department of Interior presented a revision of its proposed policy before a committee of the U.S. Senate regarding five bills being proposed (U.S. Department of Interior, 1978). That testimony confirms and strengthens Hinds' synopsis above. Two features of this testimony require mention here. First, the residency requirement would be strengthened to require "substantial involvement" in the actual farming operations. Secondly, the limitation would be such that two adult individuals only (whether related or not) could each have 320 acres of owned, with an additional 160 acres of leased land each, for a total of not more than 960 acres of land receiving federal water (U.S. Department of Interior, p. 7).

Exactly how much land will be affected by these revisions is not completely known. However, according to the Department of the Interior (Hinds, p. 6), there are "almost two million acres of land classed as excess land on projects governed by Federal Reclamation law . . ." out of ten million acres served by Bureau of Reclamation (USBR) projects. Some of this land may have alternative sources of water supply. In these cases, if the costs of the alternative water supply warrant, the lands could be withdrawn from USBR water and would not be available for sale. Further, of the total two million acres, 750 thousand acres are in the Imperial Valley Irrigation District and in certain U.S. Army Corps of Engineers projects, and the relevance of the acreage limitation to these project lands is still a matter of appeal in the courts. Altogether, Interior estimates that about 500,000 acres will be sold from USBR served projects alone, including 258,606 acres under recordable contract. About 80% of the total land affected is in California.

This completes our overview of the situation. For additional details, see Hogan and the previously cited works of Taylor, Sax, Hibbard. We now turn the discussion to a more micro-economic view of the agricultural situation in California as it has evolved under the Federal water program.

The Amount and Distribution of the Subsidy

In February 1978, a special task force from the U.S. Department of Agriculture (USDA) published "An Economic Impact Analysis" of the Department of Interior's proposed regulations. We rely heavily on this study as a source of data for analysis of the distribution and impact of the subsidy on lands served by federal water. (While conditions in California are the focus of attention here, the USDA study includes data for other affected regions as well.) Table 1 provides estimated returns to operator labor and management in the Westlands and Imperial Irrigation Districts of California as derived from this USDA study.

Each area produces largely a mix of field and vegetable crops, including alfalfa, cotton, wheat, barley, canning tomatoes, and sugarbeets. Recent county average yields and 1977 prices and costs were assumed in the budget. Water charges, opportunity cost for land at pre-project price of $750 per acre and real property taxes, as well as cash operating expenses, and machinery and equipment charges were deducted from gross revenues to derive this figure. To the extent the operator has

Table 1. Net Return to Labor and Management for New Land Settlers in Westlands and Imperial Irrigation Districts, by Size of Farm

	160	320	640
Westlands	30,120	64,240	101,480
Imperial	21,920	52,840	124,600
Adjusted	(11,120)	(31,240)	(81,400)

Source: Adapted from USDA, *The U.S. Department of the Interior's Proposed Rules for Enforcement of the Reclamation Act of 1902: An Economic Impact Analysis.* ESCS-04, Feb. 1978, tables 8, 9. This data does not exactly match that presented in the above-cited report, in that we have adjusted for double-counted real property taxes (per personal communication, Dr. Charles V. Moore, ESCS, 10 July 1978).

Note: Land charges were deducted at an assumed pre-project price of $750 per acre at 9% interest rate. At current market prices of $1,500 per acre, an additional $67.50 per acre should be deducted. We have used pre-project values to show the situation *ex ante* for a purchaser of excess lands. For reasons elucidated in this paper, the *ex post* situation (relevant to considerations of just solutions), using $1,500 per acre, may be appropriate for Imperial. These are shown in the adjusted figures in parentheses.

equity in the land, the family disposable income would exceed the labor and management returns shown in the table.

According to the USDA report (p. 12) the 1970 median family income in Fresno County was $8,622 per annum and in Imperial $8,257. Certainly, compared to these figures even the smaller family farmer in the project would enjoy a rather good income. It is also relevant to consider that the average farmer in California earns $15,000 annually from off-farm sources and that the amount of earnings are not correlated with farm size (USDA, p. 23).

It may be objected that these comparisons are fallacious because they essentially compare a business structure with personal income accounts and therefore neglect risk and financial considerations. There is something to this objection, but as a matter of fact, the risk of loss of income in farming may be no greater than that of a blue collar worker. The coefficient of variation on gross income for the five most important crops in the area averages about 6%.

In the end, whether these returns are high or low is a value judgment and our particular judgment is hardly more illuminating than that of anyone else..

It is, however, important to consider that the Department of Interior has recently estimated that the amount of the water subsidy in Westlands, including the interest on the facilities, is approximately $1,540 per acre—or slightly more than the current market value of the land (USDA, p. 2). This means that without the subsidy, if the water were charged at full cost, nearly all of the current $135 rental value of the land would be absorbed in water charges. Assuming four acre feet per year, this implies that the total cost of the water is $33.75 per acre foot. The point is that the subsidy provides all the gross $135 annual revenue to the landowner per se. In light of this fact, the distribution of the land in Westlands and Imperial acquires a certain piquancy.

In Westlands, Southern Pacific Land Co. has 80,000 acres of land under recordable contract; Boston Ranch Co., 26,000 acres; and Westhaven Farms, 11,000 acres. Of course, all this land must be disposed of within ten years at pre-project values of $750 per acre. Nevertheless, these landowners have in effect received the equivalent of an interest free loan in the amount of the difference between the price at which they must dispose of the land and its market value for ten years. If they rent out the land at its current value, $135 per acre, the annual savings is $67.50 per acre. In present value terms, the benefit to delaying the sale for ten years is $433 per acre (discounting the savings stream at 9%). Therefore, Southern Pacific Land Co. realizes about $34,600,000 more net income over the ten-year period than they would have received had they purchased the land at market value at the beginning of the period.

Unfortunately, there are no statistics on the exact distribution of the land in either area. The statistics are partly confused by the problem of distinguishing between farm owners and farm operators in the two areas. The two are quite different, partly because of the effects of the water subsidy itself.

The USDA estimates that most of the 265,000 excess land in Imperial is owned by 204 partnerships and corporations for an average of 1,299 acres each, and operated by 150 farm operations, for an average operation of 1,767 acres.

In Westlands, 434 owners control 224,000 acres of land under recordable contracts. While this is an average of only 516 acres each, the three owners mentioned above have nearly one-half the total, so the average of the rest must be about one-half this amount. Significantly, while there are 1,822 total ownership units in Westlands, with an average holding of only 316 acres, there are only 199 farm operations in Westlands farming an average of 2,889 acres. The average farm operation is over nine times the average ownership size. It seems clear that when given a choice between the life of the *rentier* and the life of a dirt farmer, the owners know where the values lie.

In sum, it is reasonable to say that from the perspective one would normally have of the "family farmer," the amounts of money being made and the distribution of public funds through the water subsidy, are little short of the grotesque. The agitation against the present situation is well founded.

However, it is equally clear that the U.S. Department of Interior proposals to correct this situation, while better than the present, are hardly close to the ideal—if indeed they are workable at all. Consider the lottery aspects. Under the proposed revisions, excess lands will be disposed of at a fixed, pre-project price of $750 per acre. The new owners will acquire immediately the difference between this amount and the $1,500 capitalized market rental value of the land as a windfall gain. On

640 acres of owned land, therefore, their capitalized net worth will rise by $480,000 for an investment of the same amount, or an increase of 100%. Since there appear to be no other clear qualifications other than ability to pay the $750 per acre cost and reside within fifty miles of the land, virtually every person in the area who does not already have 640 acres of such land would be a fool not to enter his name in the lottery. The logic, even the sense of such a program escapes us. It will quite clearly accelerate the division between farm owners and farm operators and continue the subsidization of the *rentier* class. The only difference is that the landowners will now have to live in the vicinity of the farm to receive the coupons. Nor can one be sanguine about enforcement of these, or even improved, regulations. The premise of the revisions is the same as that for the past three-quarters of a century of successful avoidance of the provisions of Federal Reclamation Law. We see nothing to change that fact. Alternative policies will be discussed in the last section, but first it is necessary to deal with the *bete noir* underlying all this controversy: the problem of economies of size.

Farm Size and the Efficiency of Agricultural Production

If there is one point upon which virtually all parties to the controversy over the acreage limitation agree, it is that there are important gains in the efficiency of agricultural production as farms increase in size (at least up to a limit of very large sized farms). Proponents of the acreage limitation use this idea in support of their argument that without some kind of protection to the small family farmer, these farmers will be destroyed in the competitive struggle with large farmers. Opponents of the limitation use this idea to support their argument that if farms are artificially restricted to small sizes, the efficiency of food production will decline and food prices, accordingly, rise. Economists use this idea to define the policy problem created by the acreage limitation in terms of a trade-off function between the incompatible objectives of efficiency of food production and the equitable distribution of water subsidies. In light of the central importance of economies of size to the controversy over the limitation, it is necessary to spend some time here to make sure that it is understood what this concept means, and that what it means is a valid description of reality.

An important intuitive basis for the belief in economies of size is "The Survival Theory." This theory, developed by Stigler and others (Madden and Partenheimer), holds that under reasonably competitive conditions the various firms in an industry will be driven toward the lowest point on the long-run average cost curve (LAC) for that industry. If this is true, then two conclusions seem to follow: (*a*) that a frequency distribution of firm sizes will reveal the lowest LAC point, because firms will tend to cluster around that point; (*b*) that if technology or other forces shift this point out over time, this fact will also be revealed by a tendency for average firm sizes to increase. Thus, for example, in agriculture the survival theory seems to permit one to infer from the fact that average farm sizes are increasing, the conclusion that there exists significant economies of size. This logic undoubtedly accounts for the nearly universal belief in economies of size in agriculture. However, the conclusion does not necessarily follow from the premise. Increasing average farm size does not necessarily imply the presence of economies of size; it only implies the absence of significant diseconomies of size.

In order to see why this is so, consider figure 1 (from Dean and Carter, fig. 8, p. 37)

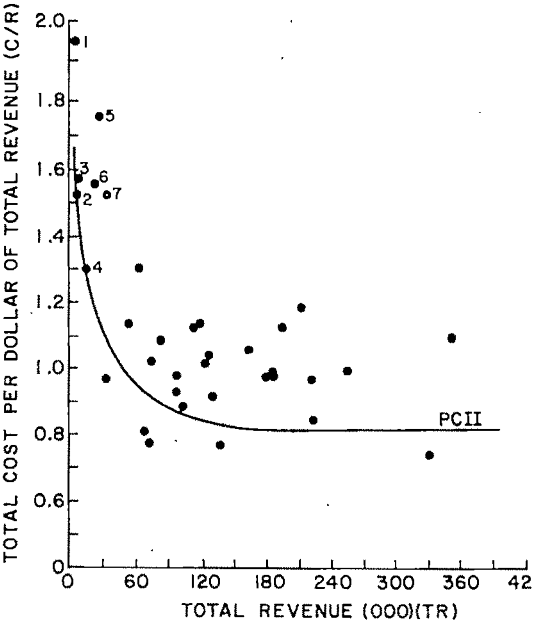

Figure 1. Cost, revenues Yolo County farmers, 1958

which is representative of most studies. Through farm account studies, the ratio of total cost to total revenue, C/R, is computed for each individual farmer. Then a scatter of these C/R observations is plotted against the measure of size—either acres farmed, or gross revenue. Last, the LAC curve is fitted to the bottom of this scatter between the farmers with the lowest C/R ratios at different sizes. The PCII curve in figure 1 is derived from a linear programming model by Dean and Carter and is not statistically fitted, but may be regarded as a LAC curve for present purposes.

Now, as shown in figure 1, some farmers have C/R ratios much greater than 1.0 and others much less than 1.0. Those at a C/R ratio of one are making normal profits; those above, losses (less than opportunity costs); and those below, excess profits. It is likely that those farmers who are achieving above average profits will want to invest in land to expand their operations and, thereby, increase their total net annual income. They will likely buy out those farmers experiencing losses. As this process proceeds, the farms of the superior managers will increase in size, the numbers of farms operated by inferior managers will decrease, and average farm sizes will increase. This process is not necessarily associated with economies of size: it would proceed even if the LAC curve were perfectly horizontal over all size ranges.

Thus, there are two quite distinct survival theories to consider. Both predict increasing farm size. However, the first survival theory, S_1, attributes the cause to economies of size, or decreasing LAC, while the second survival theory, S_2, attributes the cause to different managerial abilities among farmers, together with the natural desire to increase net annual income or total wealth. It is, of course, extremely important to find which of these theories is true in relation to the acreage limitation. If S_1 is true, any change in the existing distribution of farm sizes would increase the C/R ratio. Thus, reducing farm size would imply a move in the direction of inefficiency. If, on the other hand, S_2 is true, then the change would be inefficient only if the allocation of land from larger to smaller size farms coincided with an allocation from superior (low C/R) to inferior (high C/R) farm managers. It is, of course, possible that both theories are true, but unless their relative importance is known the efficiency consequences of any proposed acreage limitation cannot be ascertained.

The conventional theoretical model of economies/diseconomies of size usually reveals a "U" shaped LAC curve. This is rarely found in agriculture. Instead, the typical curve is obtuse angled or (if one may indulge in "appropriate terminology") appears to be a "Lazy L." PCII in figure 1 is typical in the literature (Madden and Partenheimer). This fact would appear to support S_1 over S_2, but this inference is not necessarily true because S_2 would also predict a "Lazy L" curve. The reason is the migration of managerial ability through different farm size categories. As the superior farm managers increased the size of their holdings, they would bring low C/R ratios with them and cause the average C/R ratio in range of the larger sizes to decline. Conversely, as inferior farm managers decreased in size, or stayed where they are, their high C/R ratios would become a progressively larger proportion of the total in the range of lower sizes. Thus, the simple slope of LAC does not provide a test between S_1 and S_2.

However, there are certain theoretical, even philosophical, differences between the two theories that do provide some grounds for a test. S_1 envisages the farmer caught in the grip of technical-structural determinants of economies/diseconomies of size. Thus, S_1 would predict (*a*) comparatively small differences in C/R between farmers of the same size, with comparatively large differences in C/R between farmers of different sizes; and, (*b*) that the variations between farms of different sizes would have a systematic quality such that there would be an area of optimum size of farm, in which many farms are concentrated, and the smaller the farm, the greater the C/R. S_2, on the other hand, implies a rather open production environment in which the manager is more free to maneuver. Thus, S_2 would predict (*a*) that variations in C/R between farms of the same size would be larger than variations in C/R between farms of different sizes; and (*b*) consequently, there would be little clustering around a particular farm size, with no systematic variation in C/R values across farm sizes. Of course, these are the implications of S_1 and S_2 in extremis, as archetypes. Empirical tests are needed to see which most closely approximates reality.

The few remaining pages of this section are devoted to an examination of some data relevant to the S_1, S_2 theories. Rather than attempt to survey all the studies of economies of size, we have elected to focus on the series of studies of Yolo County cash crop farms under direction of Harold O. Carter and Gerald W. Dean. While we shall disagree with some of the conclusions reached in these studies, our disagreement in no way detracts from our admiration of these pioneering efforts and the high scientific standards under which the studies were performed.

First, we turn to a closer inspection of figure 1. These observations were taken from a study of Yolo County farmers in 1958. We shall not go into the details underlying this data except to say that the costs include imputed land costs, that the farms were chosen from a relatively homogeneous group, and that, in the judgment of the authors, "the Yolo County area appears sufficiently representative of many other irrigated field crop areas of California and elsewhere in the West (in terms of types of crops, size of machinery and equipment, etc.), to suggest a similar pattern of cost relationships" (Carter and Dean, p. 277). (Of course, farms growing certain specialty crops such as fruits, nuts, and vegetables might well differ.) Now, it is clear that if a nonlinear function were to be fitted to this data with regression techniques, it would have the shape of PCII, and exhibit economies of size, on the average, to the range of around $160,000 TR, with insignificant economies/diseconomies thereafter.

But it is also clear that a good part of this regression line is due to the influence of the seven, smallest (and most inefficient) farm observations. Indeed, if one were to put these seven to the side, and fit a regression line to the remaining twenty-seven observations, the resulting regression line would be horizontal, for all practical purposes, at a *C/R* ratio very close to one. We have, in fact, verified this conjecture with data read from the graph. However, the original data are no longer available and only thirty-four of the reported thirty-seven observations are detectable in the original scatter. The plotted data is sufficient, in any case, for our present purposes.

The conclusion would then be that there are no appreciable economies for sizes beyond the $45,000 TR level. The difference is highly significant. At a very rough average figure of $250 per acre of rotation for the owner-operator (Dean and Carter, table 5, p. 23, and p. 39), economies of size would cease at about 180 acres, rather than at about 640 acres as before. On a weighted average acreage basis, these seven smallest farms represent even less of the total than their numbers and should not be permitted to have such enormous impact on the analysis. This suggests that in studies of economies of size, either two or more regressions should be run on the data according to how they are divided into distinct groups, or other, more sophisticated, techniques of statistical analysis should be used to determine the boundaries of the conclusions drawn from such data.

The second aspect of figure 1 that deserves emphasis is the very high variation of the individual observations about the regression line. It is little short of amazing that while *C/R* ratios for the thirty-four observations vary from about .75 to 1.20, or ± 22%, between individual farmers, these variations are not related to size. Clearly, there is much more involved in the determination of efficiency of agricultural production than mere farm size.

Thus, with respect to these data at least, S_2 appears superior to S_1. Indeed, even the seven most inefficient farmers of figure 1 may simply be vestigial remains of a selection process against poor management, rather than victims of disabilities caused by insufficient size. While one must be cautious in projecting on the basis of only one set of observations, we agree with the authors that the Yolo County farmers are not atypical of western irrigated crop farmers and believe that inspection of the individual observations underlying other, "Lazy L" type, LAC curves in the literature would reveal similar relationships. (See, for example, the very wide confidence intervals around the "Lazy L" curve in Moore, fig. 7, p. 46.) In any case, it does not seem to us that the data in this particular study supports the authors' broad conclusion that, "from a policy standpoint, the results clearly indicate the economic inefficiency associated with development programs limiting farm size in similar agricultural areas to 160 or 320 acres. If such size limitations appear desirable on social and other grounds, the sacrifice in efficiency should be clearly recognized" (Carter and Dean, p. 277). This conclusion, as the authors observe, perhaps rests more on their synthetic than on their statistical studies (Carter and Dean, p. 276).

In 1965 Wildermuth and Carter resurveyed these same Yolo County farmers. For analytical purposes they employed the Farrell Method (Wildermuth and Carter, pp. 178–79) of computing the comparative efficiencies of the farmers in the two periods. In this method, "the overall efficiency [of a firm] is equivalent to the ratio between the minimum observed cost per unit of production and the average cost for the firm in question." While this method is obviously subject to the danger of the reference, minimum *C/R* firm being a "fluke," this problem will not be gone into here.

Figure 2 presents in graphic form Wildermuth's data (table 4.8, pp. 51–52) on the efficiency and size relationships for each farm in 1958 (the beginning of the arrow) and in 1965 (the head of the arrow). This figure has more than a little resemblance to those remarkable photographs of 'cloud chambers' in studies of particle physics and, indeed, it would perhaps take the genius of a Murray-Gellman to crack the cipher. This impression of mystery is largely confirmed by the extensive statistical analysis of this data by Wildermuth and Carter (table 2, p. 190) which indicates a great deal that cannot be said in general, but very little that can.

Their regression analysis attempted to explain 1965 efficiency by the following variables: (the numbers in parentheses are the order in which the stepwise regression introduced the variables) 1958 efficiency (7), age (4), education (6), index of innovativeness (1) (the rate of adoption of new technology over the period), index of intensiveness (2)—comparative product per acre, total crop acres (3), and equity ratio (5). The R^2 was .6523, with only "innovativeness" and "intensiveness" significantly different from zero at the 95% level. E. L. Michalson, a discussant of the paper, observed, "that these two variables overshadow all the others may occur because they are both estimates of managerial ability or entrepreneurship" (p. 197).

The authors themselves believe that because of the rather high correlation between total crop acres and "innovativeness" (.4050) and intensiveness (−.3038) that these variables "covered up" (p. 189) the effect of size on efficiency. But, obviously, if these variables were eliminated, the regression equation itself, including total crop acres, would be reduced to virtual meaninglessness. A further problem with innovativeness is that if large size farmers in 1958 were growing farmers (for whatever reason) and they continued to grow over 1958–65 (which many of the large farmers of 1958 did), they would in the course of expanding machinery capacity naturally adopt more up-to-date technology. One questions whether this variable is wholly legitimate, but its elimination would reduce R^2 to about .29.

Perhaps the most surprising result is that not only does 1958 size fail to account for much of

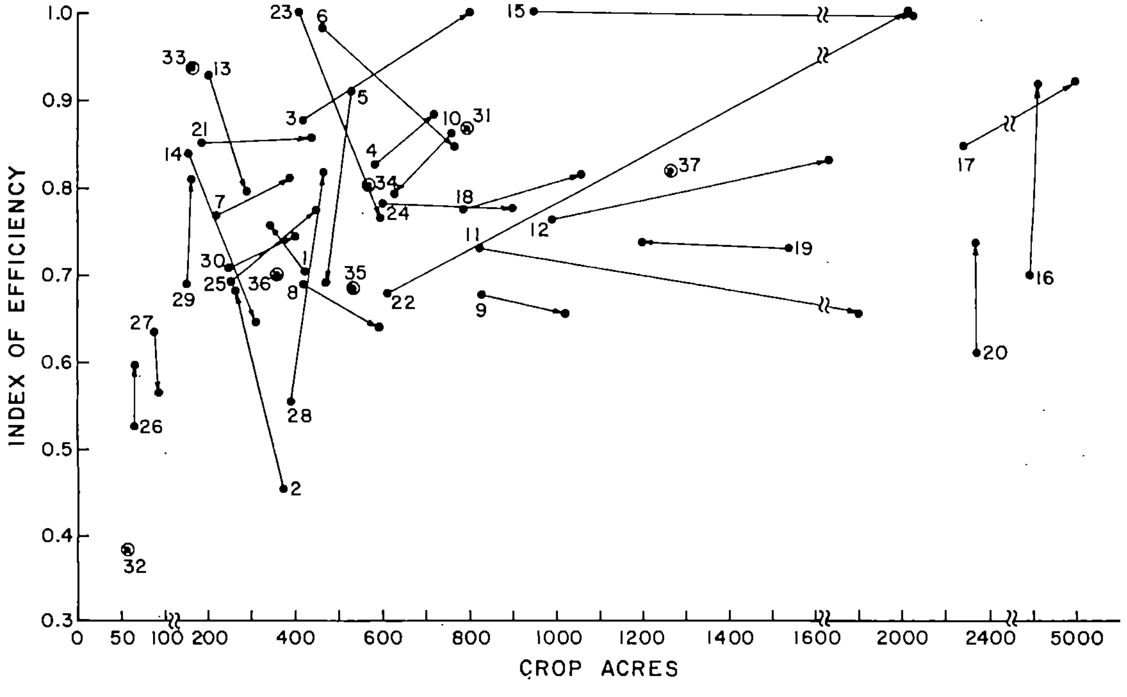

Figure 2. Changes in size, efficiency Yolo County farmers 1958–1965

1965 efficiency, but even 1958 efficiency fails to account for much of 1965 efficiency! Thus, if one were to attempt to test between S_1 and S_2 by asking whether farms are efficient because they are large (S_1) or large because they are efficient (S_2) the data fail to support either hypothesis, because efficient farms in 1958 may not be efficient in 1965, and vice versa.

Finally the seven exit farmers, indicated by the circled points, were reported to have exited for no systematic reason, and age accounts for only two (p. 182). Thorstein Veblen was once asked how he could master so many languages; he replied, "I simply write each word on a blank sheet of paper and stare at it until the meaning comes to me." We have tried the "Veblen Method" on figure 2 to no avail. Perhaps a clue lies in this background information: during this period the Bracero program was phased out. Farmers were forced to mechanization or to employ higher priced domestic labor and this caused a cost-price squeeze such that the break even point rose from an efficiency value of .71 in 1958 to .80 in 1965 (p. 1978). Thus, farmers confronted quite a large investment decision in this period. The response to this problem could be either to purchase the machinery, to sell the farm, to rent the farm to others, or to purchase larger units of machinery and rent land from others. Now virtually all the expansion of farm size through this period was by means of rented land (p. 176) and perhaps the contractions were through renting less land or renting out some of the land. This suggests that the response may have been determined by the managerial-organizational differences in "family" as distinguished from "corporate" forms of agricultural production (see the preliminary treatments of this theory in Seckler, 1976 and 1970). Renting land in or out is an adaptive mechanism similar to custom or cooperative machine utilization techniques. Interestingly enough, the use of custom services declined between the two surveys. It is also possible that many farmers found it more profitable to decrease efficiency and produce high valued crops rather than produce low valued crops at high efficiency. Perhaps all these factors of management, institutional structure, economies of large machines, and rental devices of managerial specialization and machine sharing could be put together in more general theory that would explain figure 2. We do not know, but the 1965 study apparently caught these farmers in a period of disequilibrium and we would hesitate to derive any firm conclusions without a third follow-up study (which would be a valuable contribution to the literature in any case). But three lessons may be drawn from this section: that facile generalizations of economies of size drawn from S_1 theories alone will not stand up; that the profession needs much more hard, empirical studies of intertemporal changes, such as presented by Wildermuth and Carter, (and perhaps less synthetic studies) to find the truth; that, in the present state of knowledge, no judgments on the dynamic efficiency aspects of any acreage limitation can be derived from a priori principles, such as the S_1 model. Hypotheses posed within a more general framework, such as that recently proposed by Leibenstein, are more likely to yield detailed understanding of the relationships.

Policy Instruments for Administering the Federal Water Subsidy

The central problem is to determine the most expeditious means of regulating the distribution of the subsidy to meet important social objectives. We have listed these objectives as efficiency in food production, regional economic development, provision of opportunity for small farmers, and the creation of viable rural communities.[3] To this list should be added cost-effectiveness in government programs and administrative feasibility.

Now the question is: How can the federal government regulate its water in a manner conducive to these several incommensurable objectives? In order to address this question we first shall outline a system of rules and administration that we believe would permit market forces to find a solution conducive to all these objectives. Of course, the emerging solution will not represent the optimum of what could be attained if the system were designed to serve only one objective alone. There will necessarily be a trade-off between objectives. However, we do believe that the system proposed will reach a nearer-to-satisfactory state between all these objectives, on the whole, than either the present situation or the proposed revisions.

The first point of departure from the present and proposed regulations is to control the water, not the land. Hitherto, the idea has been to control the subsidy on the water indirectly through control of the land by means of an acreage limitation. But if the objective is ultimately to control the subsidy and the subsidy is attached to the water, then the control of the water is the direct route, and, through the control of the water, one can also exercise indirect control over the land.

The second element in this program is a two-tier system of water pricing for federal water. The base price of the water will pertain to water used up to a certain amount—so many acre feet per year. This will be an administrative price periodically determined by a federal water board for particular areas served by federal waters. Any water purchased by a user over the base quantity will be purchased at an amount determined by competitive market forces.

Third, the right to purchase base water is determined only by an affidavit testifying that the purchaser is a bona fide farmer. The criteria for being such a farmer should include (*a*) that he lives on the farm, (*b*) that he himself manages the farm, (*c*) that the farm is not leased to other parties, nor is it operated by tenants, (*d*) that the base water will not be sold to other parties. Any violation of these provisions will require reimbursement of the difference between the base price and the market price of the water used, and loss of the right to purchase water at the base price for a period of years.

Fourth, the land can be leased at any time, but the price of the water for leased land is the market, not the base price. In the event of sale of the land, it must be sold at the pre-project value, as determined by the water board.

There are no other regulations. The farmer can farm as much land as he wishes with his base water allocation. Qualification for the base amount is irrespective of spouse and number of children. Those who purchase water in excess of the base amount at the market price are exempt from all the regulations. They need not live on the farm, nor be farmers at all; they can sell whatever land they have, at whatever price it will bring (net of the estimated difference between the pre- and post-project value of the base price water in the case of land served by base water). In essence, this structure gives the individual the opportunity to play by one of two sets of rules. If he wants to play by the rules of the market, he can buy himself out of governmental regulation by paying the market price of water. If he wants to benefit from the lower price of base water, then he plays by the rules of the administrators. This is the principle of the system; some of the administrative details and impacts require further comment.

Determination of the base quantity and price of water entails a value judgment on the size of farm the public wishes to subsidize and the amount of subsidy it wishes to provide to the farmer. One would first estimate average farm incomes by size of farm for the region in question (as in table 1). Clearly, the appropriate amount of water would differ depending on physical and economic characteristics of the project area, such as soils, rainfall, growing season, and distance to markets. Then one would pick what could be considered a viable small farm size in terms of average cost of production. Next, one would assess the average income a farmer of that size should reasonably earn. The price of the base water would be determined accordingly. For example, in table 1, it appears that a 160-acre farm is a viable farm size in both Westlands and Imperial, and the base price could be considerably more than the $7.50 now charged. In Imperial, the 160-acre farm is viable at the unadjusted estimate, but perhaps is not reasonable on an adjusted basis. In Imperial, therefore, the base price may be set higher than $7.50 per acre foot but at a size level of 320 acres (adjusted basis).

It is an important consequence of this administered price that it is based upon average returns. The superior farmers in the size group can make much more, and the inferior farmers will make much less. By increasing the water price up to a point of reasonable average returns, inferior farmers will be crowded out of business. This provides an opportunity for new small and superior farmers to come into farming. Also, since the price is based on the income of the owner-operator, higher base water changes will lower the income of the *rentier* and, thereby, encourage more actual family farming.

We have said that the price of nonbase water will be determined by competitive market forces. This determination could of course be by means of a water auction. Alternatively, the price could be determined administratively on the basis of estimates of the shadow price of water. In the latter case, the board would have an important feedback in the form of the queue for rights to the water. If the queue were too long, this would indicate that the price was too low, and vice versa. The same feedback mechanism would of course operate in determination of the base water price.

One would expect the market price of the nonbase water allocation to rise to at least $21 per acre foot. The reason is that farmers using state water are now paying that amount in areas physically indistinguishable from those served by federal water. Of course this water price will also tend to crowd the large inferior farmers out of business and thereby release acreage for utilization by more small farmers or for expansion by superior large farmers. It should be noted that under the competitive conditions prevailing in the nonbase market, this land would tend to go to superior small farmers unless our skepticism regarding economies of size is drastically misplaced. For example, a price differential of only $10 per acre foot between the base and nonbase markets amounts to a $40 per acre "tilt" toward the small farmers. This is around one-quarter of the per acre returns of the most efficient farms of table 1. Therefore economies of size would have to be on the order of 25% to enable the large farmer to outbid competitively the small farmer for the land. No one, to our knowledge, has suggested economies of size of this magnitude, over this range. Thus, as inefficient farmers are crowded out by these prices, they would tend to be absorbed by superior small farmers and only the very most efficient large farmers would remain. As this process continued, the average social costs of food production as a whole would decrease and the efficiency of water use would increase.

An alternative that should be considered is whether, in this system, there should be such a strong break between the two markets. To put it another way, should the large farms qualify for some acre feet of water at the base price as the small farmer, or should they have to pay an increasing average cost on all the water they use, as the quantity used rises over the base amount. Our own opinion is that the break should remain. This permits everyone to have equal access to the subsidy and everyone to buy themselves out of regulation, on the margin, if they are willing to pay the market price. It avoids discrimination against large farmers simply on grounds that they are large.

If the two-tier system is acceptable as a rough program for the future administration of federal water, the problem remains of how to make the transition from the present situation to the future program, as determined by past administration of the water.

Application of the two-tier system to completed projects or to those under construction will pose major difficulties. The situation in Westlands is, of course, much simpler than in Imperial; for Westlands has developed in full knowledge of the necessity to dispose of excess lands whereas Imperial has developed under the assurance that this requirement was not operable in their case. Under the existing process of water allocation from the federal government, through districts, to users, the federal government has no control over the price and distribution of water except that afforded by the legal proviso of the acreage limitation itself.

However, it is also clear that the alternatives of a two-tier pricing system could be used as bargaining positions in negotiations between the federal government and water districts to escape rigorous enforcement of the acreage limitation. If the districts were confronted with either these alternatives or a literal interpretation of the 160-acre limitation then, whichever they chose, the maldistribution of the subsidy that now prevails would be alleviated. The federal government is not nearly so powerless in the face of this issue as some would like to believe, or to have others believe.

In Westlands, if the two-tier program were made operable in advance of the disposal of excess lands, it would make the problem of disposal much easier and the allocation of the excess lands much more efficient. Because of the large windfall gains assured to "lucky winners" under the present system, there will be an enormous queue of people wanting this land irrespective of their ability to farm or, indeed, even of their interest in farming. The two-tier system would shorten the queue and change its composition. The amount of the windfall gain would be reduced and it would have to be earned by being an actual farmer. The Westlands experience to date indicates that while many people have a strong preference to the life of the *rentier,* many are less than enthusiastic about actually doing the work. Thus, the program would reduce the Westlands queue to those who really wanted to earn their living through farm work, and to those who believe they had the ability to do so under reduced subsidies.

In Imperial, if the courts do require enforcement, the two-tier system offers perhaps the only equitable means of solving a dilemma of Solomonic proportions. Because of being excepted from the limitation in 1933, agriculture in this area evolved under the rule of market forces which capitalized the value of the subsidy into land values. But that phenomenon is past tense; the present owners are "stuck with the bill." On the other hand, the public has no obligation to continue the subsidy in the amounts indicated. The two-tier system [around the 320-acre level for Imperial, table 1 (adjusted)] seems to offer a reasonable compromise between these two positions.

In conclusion, it may be said that past administration of the federal reclamation program has created windfall gains for a relatively few fortunate enough to be landowners in a project area. Relaxation of the acreage limitation is not likely to have much advantage in improving economic efficiency in food production, and certainly has adverse effects on the goal of distributive justice.

The proposed regulations will not improve this situation and may even worsen it. The program of the two-tier water allocation outlined above is certainly not a panacea for all these problems; and, of course, there may be flaws in the program which we have not anticipated. But whatever the eventual mechanism adapted in the administration of federal water, at least three conditions should be satisfied. First, the distribution of the water, and not of the land, should be the point of control. Second, the amount of the subsidy per acre foot of water should be reduced substantially by higher water charges. Third, the market mechanism should be permitted a role in the allocation of federal waters. The system should be both more severe respecting the subsidy and more flexible where the subsidy is not provided. This provides an opportunity for joint administrative and market determination of the use of the water resource.

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Farm Size and Economic Efficiency: The Case of California

Bruce F. Hall and E. Phillip LeVeen

The relationship between farm size and production costs is examined using current data. The analysis indicates that relatively modest sized farms can achieve a major portion of the possible cost savings associated with size. The sources of efficiency are examined, and it is shown that factors other than labor-saving technology may be important contributors to economic efficiency. The implications of this analysis are developed for the current debate over acreage restrictions in reclamation policy. Strict enforcement of the 160-acre limit could cause a modest overall efficiency loss, but this would be borne by landowners rather than consumers.

Key words: efficiency, farm size, reclamation policy.

Issues relating to the structure of agriculture, the survival of the family farm, and particularly the desirability of recasting farm policies to better suit the needs of the smaller farmers have recently become the source of considerable controversy. The recent decision of the Department of the Interior to enforce the long-neglected provisions of the Reclamation Act (including the residency and 160-acre requirements) have added fuel to the debate over the costs and benefits of smaller commercial farms. Opponents of family farm legislation frequently argue that food costs will rise to offset the increasing inefficiency of production, while proponents of the legislation argue that equity consideration and social benefits more than outweigh higher production costs implied by such policies.

Surprisingly, while attention was devoted to the measurement of economies of size in agriculture during the 1960s (Madden and Partenheimer), there has been little recent analysis of the efficiency costs of possible restriction of farm size. For example, in the debate over the enforcement of the provisions of the Reclamation Act, there have been several efforts to determine if the 160- to 320-acre farm is "viable" (Goldman et al., U.S. Department of Agriculture), but these efforts do not attempt to estimate the possible resource costs of these regulations. Smaller farms may be able to survive, but they may require more resources to do so; hence, there could be an efficiency cost.

This paper first explores the relationship between economic efficiency and farm size. It will be shown that large farms generally have lower production costs and that restrictive policies may therefore have some impact on overall economic efficiency. However, the efficiency costs are likely to be modest (depending on the degree of restrictiveness of the particular policy). Second, it will be contended that, should size-restrictive policies be implemented, there are strong economic reasons for arguing that their primary effect will be to lower land prices and rents rather than to raise food prices.

The analysis is organized into three parts. Part 1 considers the methodology of analyzing economies of size in agriculture. Part 2 surveys the available data on economies of size in agriculture, including the results of "synthetic firm" studies of efficiency; and a sample of seventy-five "small" farms is used to study the impact of farm size on economic efficiency. Finally, 1974 Census data are examined to show the broad cost-size relationships which prevail in different kinds of crop production in California. In part 3, the relationship between production costs, rates of return, and food prices is developed, using the particular example of the effect of imposing the

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160-acre limitation on certain sectors of California's agricultural system.

The Study of Economies of Size in Agriculture

A relationship can exist between farm size and economic efficiency either because there are economies of scale in the physical production function of the farm or because relative prices are such that cost savings result from increasing size. Efficiency associated with physical economies of scale can be characterized as technical efficiency, while efficiency associated with adjusting factor use and output mix to relative prices can be characterized as allocative, or price, efficiency. Allocative inefficiency is a traditional concern of economics, but economists have turned their attention more and more to technical efficiency using the tools of linear programming and have found that it can represent a more serious resource loss to the economy than allocative inefficiency (Leibenstein). Overall economic efficiency is a function of both price and technical efficiency, and a firm is only completely efficient economically if it minimizes cost per unit of output.

In analyzing the impact of farm-size restrictions, the relevant criterion is whether economic efficiency increases with farm size; that is, whether the long-run average cost curve declines as size increases. If farm-size policies restrict farm size to the declining portion of the long-run average cost curve, they will impose a loss to the economy. What the severity of that loss will be and how policies might moderate it cannot be known without examining the sources of inefficiency associated with decreased size. If there are physical economies of scale based on the nature of the technology, the efficiency loss may be unavoidable. If, on the other hand, inefficiency results from the structure of relative prices under existing institutional arrangements for marketing and production and that structure can adjust to a new economic environment, then the efficiency costs are potentially smaller.

There are several different approaches to empirical analysis of the relationship between farm size and efficiency. A common approach is to estimate the parameters of production and cost functions using statistical techniques. There are methodological problems, however, with the estimation of production and cost functions. One problem is the inconsistency between the theoretical definitions of production and cost functions as maxima or minima and the use of techniques based on zero average errors to estimate them (Aigner, Lovell, and Schmidt). Another problem is that parametric estimation of cost and production functions requires adequate specification of the stochastic process generating the data and often requires the use of restrictive functional forms (Hanoch and Rothschild).

Most of the existing literature on economies of size in California agriculture employs nonparametric economic engineering analyses of "best practice" relationships between production costs and farm size. The least-cost packages of machinery, equipment, and other inputs for optimally organized farm units of varying sizes are identified by the use of linear programming techniques, and a series of short-run cost curves is constructed. The envelope of these curves is the long-run average cost curve and illustrates the relative efficiency of each farm size (Faris and Armstrong, Kyle and Krause, Moore, Carter and Dean, Dean and Carter). This technique is not designed to explain actual farm behavior nor to estimate all the possible economic advantages and disadvantages of size. It illustrates the relationship between production costs and size if certain assumptions—e.g., that input costs, commodity prices, and productivity of land are all identical for each farm size—are met. If these assumptions are not met, the resulting cost curves will not be realistic representations of the minimum cost curve.

An alternative to this approach uses a linear programming algorithm to construct nonparametric frontier functions from actual data (Boles 1967). The relative proximity of each farm to the production or cost frontier is an index of the relative technical or economic efficiency, respectively, of that farm. These indices range between zero and one, with 100% efficiency indicated by a score of one. Since economic efficiency is, with this measure, the product of technical efficiency and price efficiency ($EE = TE \times PE$), a price efficiency index is obtained as the ratio of economic and technical efficiency.

When the production frontier is characterized by economies or diseconomies of scale, this algorithm can be modified (Boles 1971) to include scale as an additional dimension of the problem and to compare each farm only with a subset of other farms that have the same weighted average scale. Seitz has shown that, by using this formulation of the problem, the index of overall economic efficiency can be broken down into its components, where overall economic efficiency (*EE*) is the product of economic efficiency given the scale of operation (*EES*) and the economic efficiency of the scale of operation itself (*ESE*); that is, $EE = EES \times ESE$. Since $EE = TE \times PE$, the components can also be expressed as the products of the appropriate components of technical and price efficiency ($EES = TES \times PES$ and $ESE = TSE \times PSE$). Thus, the importance of scale in the relative technical, price, and economic efficiency of actual farms can be assessed.

For policy purposes, however, it is necessary to inquire further into the reasons for efficiencies associated with size. Price and technical efficiency due to scale are partial indicators of the causes of economies of size; but in order to assess the distributional and other impacts of farm-size restrictions, more complete knowledge is needed. Measures of the relation between size, cost of production, and rate of return can be calculated directly by making use of agricultural census tabulations of agricultural production by farm-size group. These cross-tabular calculations represent average rather than optimal performance, but their advantage is that they provide an indication of the quantitative impact of size restrictions. Furthermore, it is feasible to break down individual types of farms, such as cash grains, separately and to analyze comprehensive and current aggregate data. These calculations can be used to show how acquisition of inputs, market factors, and management affect economies of size; and thus they are of primary importance in drawing policy conclusions.

Summary of the Evidence

The main conclusions of the economic engineering, or synthetic firm, studies that are relevant to this problem can be summarized briefly (Faris and Armstrong, Dean and Carter, Carter and Dean, Moore). They all found that the long-run average cost curve is L-shaped. That is, production costs decline rapidly with initial increases in size and then decline slowly, if at all. Little evidence is found of increasing costs for very large farms. Thus, most of the benefits of technology are achieved by modestly sized farms, e.g., farms of 100–320 acres (depending on crop) selling less than $75,000 in total output. The technological advantages of very large farms, such as those with 3,200 acres and over $500,000 in sales, are relatively small in relationship to the more modest-sized farms. For example, these large farms have production cost advantages of between 0% and 15% in comparison to those of the 100- to 320-acre farms. Moreover, in those studies that allowed for smaller farms to rent specialized equipment when they could not profitably own it, the advantages of technology were found to be even more limited.

In spite of higher production costs, small farms are still found to be economically viable. The "costs" used in these studies are more comprehensive than those of most studies in that they include all labor and management (including the imputed value of family labor and management) and the opportunity cost for all land and capital valued at current market values. Almost all farms larger than 80 acres incur less than a dollar of cost per dollar of sales and so must be regarded as minimally profitable, even though large farms of 1,000 and more acres have considerably lower costs per dollar of sales. In other words, a very wide range of farm sizes are found to produce at least enough income to cover all costs and the opportunity cost of capital, although large farms earn profits considerably in excess of the minimum opportunity cost of capital. This finding, which is important to the arguments in the section following in which we discuss the Reclamation Act in California, is substantiated by similar conclusions of the small farm and U.S. Census analysis.

Unfortunately, the most recent of these studies is more than ten years old. In addition, their usefulness in predicting the impact of restrictions on farm size is limited because they are very sensitive to the assumptions made in constructing the cost curves. Because they are based on assumed best practice behavior and technology, they provide no evidence that large farms actually do achieve the cost savings projected by the technique. Furthermore, they neglect the small farm because their intent is to project the advantages of expanding, rather than the disadvantages of restricting farm size. The basic assumption is that machinery and equipment must be used in a limited number of prescribed packages—the smallest of which is too large to be used efficiently by farms of less than 160 to 320 acres. There is no consideration given to the costs of smaller machinery packages or the options available to rent or contract for machinery use on small units. For these reasons, it is desirable to look at actual farm survey data that are both more current and include smaller units.

Analysis of a Survey of Small Farms in California

A 1977 survey of a sample of small fruit and vegetable farms—none producing more than $140,000 in sales and none with more than 100 acres of land in production—offers an opportunity to examine directly some of the determinants of economic efficiency (Small Farm Viability Project). The analysis shows which observed differences in the actual costs and physical productivity of these farms result from size-related factors. Two questions are analyzed: (*a*) to what extent are there technical economies of size within this limited size range, and (*b*) how important is technical efficiency in the determination of overall economic efficiency?

Evidence of technical economies of size. The Boles algorithm described above was used to construct nonparametric frontier production and cost functions, and the relative efficiency scores were calculated. Acres of land; man-days of family labor; and dollar value of hired labor, physical capital, and material expenses were taken as factors of production used in producing a single aggregated agricultural product.

The efficiency scores for the sample, when plotted against scale, showed that, while there are efficient points at every scale level, smaller farms on the average lie further from the efficient frontier. A statistical test of this hypothesis confirmed its validity, showing that the hypothesis of equal mean scores for large and small farms can be rejected at a reasonable level of significance. While the average technical efficiency score of the smaller farm is lower than the average score of a larger farm, it is nevertheless important to note that ten out of nineteen points found to be efficient have less than $20,000 in output. There is even one farm with less than $500 in sales which is classified as 100% efficient.

Since the efficiency scores of small and large farms differ, however, a scale element was included in the problem, and the efficiency scores were recalculated. The number of efficient activities increased from nineteen to thirty-two, verifying the statistical finding that a scale effect is present in the data. Of these thirty-two technically efficient farms, twenty had less than $20,000 in output.

Effect of size on economic efficiency. Calculating the effect of size on overall economic efficiency requires valuing all inputs so that the relative proximity of each farm to the cost frontier can be determined. Thus, it is necessary to impute some reasonable value for input prices, especially for family and operator labor. The usual solution to this problem is to use an assumed opportunity cost of labor in nonfarm wage labor markets to value family farm labor. Using the average nonfarm industrial wage to value family labor ($5.00 per hour), and valuing land at its rental value ($100 per acre for vegetable land and $250 per acre for fruit and nut land) and capital at an 8% interest rate makes it possible to construct the average cost curve shown in figure 1 as the minimum of observed costs for the farms in this survey.

Figure 1 shows that average costs for this group of farms are declining up to $40,000 in gross output and increasing slightly thereafter. It can be concluded fairly safely that minimum average costs are, if not increasing, at least nondecreasing throughout the range of census-Class-I farms and perhaps including some Class-II farms. It is interesting to note that, while this curve has the same shape as cost curves derived by synthetic firm studies, it is shifted to the left relative to earlier findings.

It is possible further to elaborate the effect of scale on the economic efficiency of this set of farms. The procedure described previously

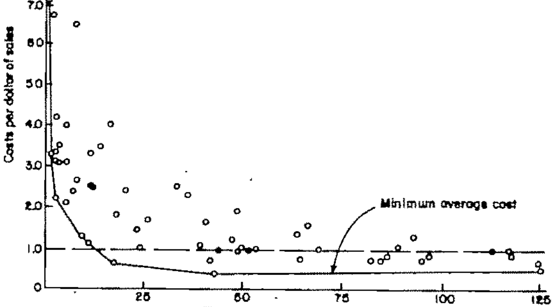

Figure 1. Average costs: small farm survey

for breaking down overall economic efficiency into its components has been used to construct table 1, following the method developed by Seitz.

There are two major conclusions to draw from this table, keeping in mind that the lower the efficiency index the greater the influence of a particular element in the table in moving the sampled farms away from maximizing output per unit of input. The first conclusion follows from the fact that all the elements in the second row are larger than the elements in the third row; that is, efficiency given scale is less likely to be achieved than scale efficiency. This indicates that inefficiency given scale is a more important cause of the failure of farms to produce efficiently than is the efficiency of the scale itself. That is, $ESE > EES$, $TSE > TES$, and $PSE > PES$.

The second conclusion is that, because the elements of the second column are larger than the third, price or allocative inefficiency is more important than technical inefficiency in causing farms to fall short of achieving the efficient production frontier. This observation applies to all three rows of the table, that is, $TSE > PSE$, $TES > PES$, and $TE > PE$. Thus, the analysis of the production function has been integrated with analysis of the cost function of this sample to show that, while there are inefficiencies for the small farm, they are not as large as inefficiencies which are unrelated to size. Further, price inefficiency is more important than technical inefficiency in explaining overall inefficiency of either type.

This confirms the findings of synthetic firm studies of costs, but it shows that the relative magnitude of efficiencies due to size is smaller than that of efficiencies unrelated to size. Do these relationships appear in aggregate data on California farms? To what extent can the results of this analysis be extrapolated to other kinds and sizes of farms? The remainder of this paper will explore these issues in the broader context of agricultural census data on California agriculture.

Table 1. California Small Farm Survey: Average Efficiency Scores, 1977

	Economic (*E*)	Technical (*T*)	Price (*P*)
Efficiency overall (*E*)	.275 (*EE*)	.665 (*TE*)	.413 (*PE*)
Scale efficiency (*SE*)	.584 (*ESE*)	.858 (*TSE*)	.680 (*PSE*)
Efficiency given scale (*ES*)	.471 (*EES*)	.775 (*TES*)	.607 (*PES*)

Source: Computed.

Agricultural Census Data and Cost-Size Relationships

The agricultural census provides a comprehensive accounting of the costs and returns for a wide array of crop farms in different economic size classes (defined in terms of total sales). These data refer to the average farm within each size class and reflect all sources of economies of size. However, in order to compare the performance of different sized farms, several adjustments in the reported costs must be made to eliminate inherent biases.

To make production costs of different sized farms comparable, all production inputs must be incorporated into the cost estimates. The agricultural census does not report the contribution of unpaid operator and family labor. Since large farms use relatively less unpaid labor than small farms, this omission of unpaid labor biases the reported cost estimates in favor of small farms. To correct for this bias, the value of unpaid labor must be included in the costs of all farms, and this is done in the following way.

Using the standards established in the synthetic firm studies, the number of acres required for one full-time manager is estimated for each crop (160 acres for fruit and vegetable crops, 640 acres for other crops). Farms requiring more than one full-time manager are assumed to hire the additional labor while farms requiring less than a full-time manager are assumed to employ the operator's time in proportion to the managerial requirement. The value of this contribution is imputed at the rate of \$20,000 per year for full-time work for all farm operators, except those of corporate farms. The figure of \$20,000 is chosen on the basis of full-time hired manager salaries on large farms. It may overstate the opportunity cost of smaller farm operators; and if it does, the costs of small farms may be overstated somewhat. This point will be developed in greater detail in the next section.

This procedure is based on an assumption that the operator's main work activity, even on the smallest farms, is that of management and supervision, not field or harvest work. That is, the operator's opportunity cost is assumed higher than the wage rates for hired field workers and so it pays even the part-time operator to hire out most of the nonmanagement work activities. The census provides evidence to support this contention. For example, small farms are at least as dependent on short-term hired labor (workers hired for less than 150 days per year) as large farms. On the other hand, large farms employ considerably more long-term labor (workers hired for 150 days or more). This suggests that unpaid operator labor substitutes for long-term, permanent workers whose functions tend to be management and supervision, rather than for short-term labor whose functions tend to be associated with field and harvest activities.

The second adjustment of reported census costs is the exclusion of land rent and real estate interest payments. Large farms tend to rent more land and have relatively higher debt-equity ratios than small farms. Reported census costs, therefore, reflect greater rent and interest payments of large farms, which are not related to real resource productivity differences, but rather to differences in financial organization. Excluding land costs eliminates these nonproductivity differences. Moreover, land costs are excluded because they are not independent of other production costs and play a different role in the determination of prices and profits than do other input costs. As will be shown, the analysis of the distribution of efficiency costs of farm size restrictions requires that land be treated separately from other costs of production.

Finally, the opportunity cost of capital, estimated at 8% of the market value of the stock of machinery and equipment, is added to the reported census costs, while the interest paid on debt for machinery and equipment is deducted from reported census costs to eliminate the effects of different debt-equity positions. Therefore, the adjusted costs derived from the census data reflect the full economic value of all resources employed except land.

Table 2 and figure 2 provide the adjusted cost estimates for five different crops over the top four census size classes. The costs are expressed as the ratio of total adjusted costs to the total sales for the average farm in each size class. That is, a ratio of 1.00 implies that, for each dollar of sales, one dollar of inputs is required; and there is no residual return to land. As can be seen in figure 2, the production costs derived from the census data are consistent with the other two sources of evidence on cost-size relationships. In particular, all three sources of evidence indicate that, in fruit and vegetable crop production, long-run average costs decline rapidly for small farms of less than $40,000 in total sales; and thereafter, costs do not decline significantly. Both the census data and the synthetic firm studies agree that production costs of highly mechanized field crops decline rapidly up to $50,000 to $70,000 in total sales and then modestly thereafter.

The Sources of Farm Efficiency

In order to assess whether farm size restrictions will force higher cost farming techniques on agriculture, it is necessary to examine the sources of the apparent cost advantages of large farms. The census provides a limited insight into the reasons behind the lower costs and higher profits of large farms.

Economies of size, whereby large farms reduce their costs by spreading fixed machinery and labor costs over more land and output, are evident in the census data. Per acre investment in machinery is 20% to 300% greater on Class-Ib through Class-IV farms than it is on Class-Ia farms (table 2). An analysis of the annual costs of machinery, custom hire services, hired and operator labor, and contract labor services shows that a major portion of the total cost advantages of large farms shown in figure 2 can be ascribed to such economies of size, especially in the mechanized crops (LeVeen, pp. 21, 22).

Barring a major reversal in the relative prices of labor and mechanical technology, it therefore seems likely that some of the cost advantages of laborsaving technology will be lost under the imposition of restrictive policies with the magnitude of the efficiency loss varying according to the degree of restrictiveness of the policies. The loss could be moderated through the implementation of machinery-sharing arrangements to eliminate some of the excess machine investment which might result from such policies. However, unless the production on the new smaller farms were to be coordinated as it was on the prepolicy large farm units, most of the technical economies of size advantages will be lost, even with greater machine-sharing.

Pecuniary economies of size, especially in volume discounts for purchased inputs, are

Table 2. Economic Characteristics of Farms in Census Data, California, 1974

	Economic Class of Farms				
	Ia	Ib	II	III	IV
	$100,000 and over	$40,000–$99,999	$20,000–$39,999	$10,000–$19,999	$5,000–$9,999
	$				
Cash grain farms					
Total sales per farm	400,000	67,667	29,200	14,000	7,350
Irrigated cropland per farm (acres)	807	139	73	37	27
Sales per acre	344	196	155	130	104
Value of machinery per acre	101	122	128	143	202
Total production cost per dollar of sales[b]	.550	.636	.703	.786	1.070
Cotton farms[a]					
Total sales per farm	542,050	64,278	29,112	14,537	7,068
Irrigated cropland per farm (acres)	1,300	195	93	47	24
Sales per acre	421	332	321	311	291
Value of machinery per acre	105	251	218	312	466
Total production cost per dollar of sales[b]	.637	.693	.701	.836	1.041
Sugar, hay, and other field crop farms[a]					
Total sales per farm	529,719	62,995	28,716	14,405	7,354
Irrigated cropland per farm (acres)	1,018	183	89	48	25
Sales per acre	498	261	232	177	150
Value of machinery per acre	113	164	173	182	280
Total production cost per dollar of sales[b]	.634	.696	.726	.775	1.149
Vegetable farms[a]					
Total sales per farm	859,709	67,158	29,965	12,660	7,385
Irrigated cropland per farm (acres)	703	61	33	15	9
Sales per acre	1,141	1,011	782	806	758
Value of machinery per acre	190	413	314	520	673
Total production costs per dollar of sales[b]	.720	.754	.730	.805	.980
Fruit and nut farms[a]					
Total sales per farm	332,723	63,170	28,271	14,336	7,276
Irrigated cropland per farm (acres)	303	73	36	22	12
Sales per acre	1,030	789	680	568	440
Value of machinery per acre	203	328	279	343	386
Total production cost per dollar of sales[b]	.757	.749	.786	.805	1.114

Source: U. S. Bureau of the Census, *Census of Agriculture, 1974. Volume 1, California, State and County Data,* part 5, 1977, table 33.

[a] Characteristics given for the average size farm in the size class.

[b] Production costs include all reported expenses (including purchased inputs, hired labor, depreciation, and taxes), plus the opportunity cost of machinery and equipment (estimated at 8% market value) and the opportunity cost of unpaid operator and family labor (see text for estimating procedure). Costs exclude all rent on land and interest on farm real estate.

thought to be significant for large farms (Faris and Armstrong). The agricultural census provides sufficient data to analyze only the costs of fertilizer to different sized farms, and this shows that fertilizer prices are constant over the entire range of farm sizes except for the

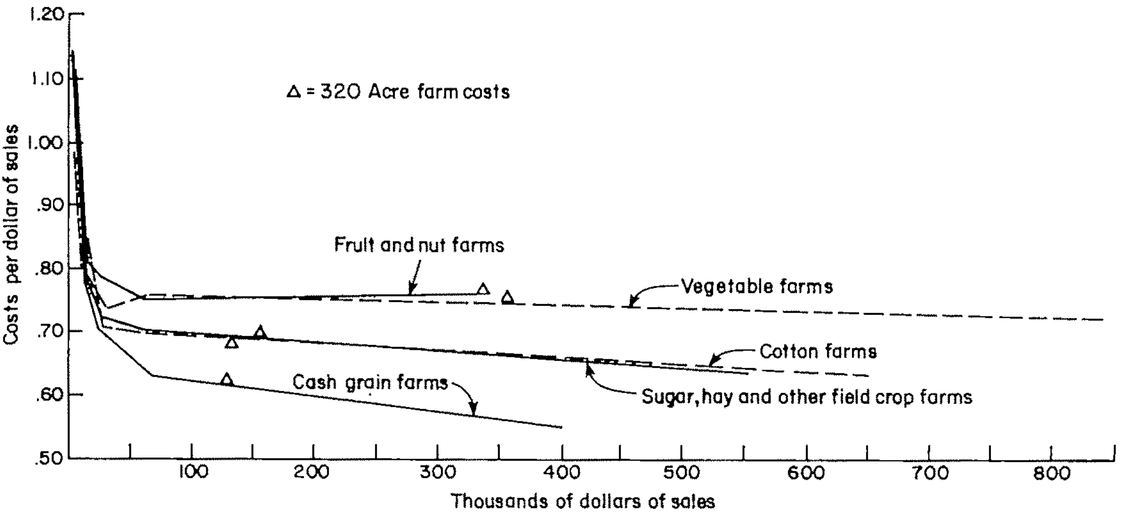

Figure 2. Average costs: 1974 California agricultural census

smallest class in which prices are 5% to 20% higher. An analysis of the combined expenditures reported in the census for fertilizer, pesticides, seed, and fuel for farms in all size classes shows that Class-Ia farms do have slightly lower overall costs for these items, equal to between 0.5 and 2.0 cents per dollar of sales. However, it cannot be determined if this cost savings derives from lower input prices or from more efficient use of the inputs (LeVeen, p. 22). In either case, the cost advantages associated with purchased inputs do not contribute in any substantial way to the overall advantages of large farms, and restrictive policies should not result in much higher resource costs from this type of economy of size.

In addition to the above sources of efficiency, large farms appear to have other significant advantages. The census shows that sales per acre for all four kinds of crop production are higher, by amounts ranging from 20% to 100% on Class-Ia farms than on smaller farms (table 2). Three reasons can account for this phenomenon. First, large farms probably have greater access to high-quality resources. For example, large farms have relatively more irrigated land. Second, large farms may produce more per acre because they are better managed. In cotton and other field crops, yields on similarly irrigated and fertilized land are higher for large farms, suggesting the possibility that resources are better utilized (as a result of management) on these farms. Finally, large farms may be able to sell more of their output because of greater market access and the availability of premium prices for large volume producers. These advantages appear to be particularly important to fruit and vegetable producers. The census data are not sufficiently detailed to allow an investigation of the prices received for particular crops by different sized farms so the relative importance of market access, management, and resource quality factors cannot be assessed. However, these combined factors may account for at least as much of the cost advantages of large units as do technical economies of size.

Should farm size be restricted, the effects of market access, management, and resource quality factors on the costs of the resulting small farms are less easily anticipated than the effects arising from mechanization. For example, if large farms with high quality land are subdivided, the resulting small farms may have higher quality land than is typical of similarly sized farms reported in the census. Therefore, they will have lower costs than indicated in table 2. Likewise, if farm size restrictions also restrict the mobility of skilled managers and the resulting small farms are run by more skilled farmers than is now the case, costs may not decline as much as indicated in table 2. Of course, it may be that smaller farms will not be able to attract high quality management, and restrictions on farm size will drive the most skilled farmers out of agriculture.

It might be argued that small farms can overcome the disadvantages implied by limited volume sales through cooperative marketing and that farm size restrictions need not imply less efficient marketing (and higher farm costs). However, since there appear to be real economies of size in the handling, distribution, and processing of crops, the small-farm cooperative will have to contend with the costs of dealing with many small accounts, just as would the conventional marketing system. In short, improved marketing arrangements may help to offset the disadvantages now experienced by the small farm but to a limited extent only.

Finally, although the census data do not allow an investigation of such factors, at least some of the cost advantages of large farms described above indirectly results from past public policies relating to agricultural research and extension, taxation, marketing, and commodity pricing. Other research has shown these policies to have stimulated the large farm relative to the small farm (e.g., Tweeten and Quance, Carlin and Woods, Jamison). In assessing the costs of restricting farm size, it ought to be recognized that some of the current cost disadvantages of smaller farms could be moderated by the redirection of other public policies to favor smaller farms.

Agricultural Efficiency and Farm-Size Policies: A Case Study of the Reclamation Act in California

Largely as a result of two recent court decisions upholding the applicability of the acreage and residency requirements of the Reclamation Act to two large irrigation districts in California, almost 1.1 million acres of federally irrigated land owned and farmed in large tracts are slated to be sold in 160-acre parcels (USDA, pp. 6–8). Also, there are strong indications that the Department of the Interior will begin enforcing the long-neglected "residency" requirement of the Reclamation Act which will effectively eliminate absentee landownership and curtail the practice of land leasing in these districts. If the 1.1 million acres must be sold in 160-acre parcels to those who will live on it, the size of the average farm operating unit will decrease from its current 2,500 plus acres to closer to 320 acres per farm. If the residency requirements are imposed on the remaining 2 million acres of California's federally irrigated land, it is likely that almost another million acres of land, now leased to other farmers, will eventually be sold to resident farmers and farm size on this land will likewise diminish substantially.

In this part of the paper, the census data discussed above will be used to estimate the probable magnitude of the efficiency costs of restricting farm size in the reclamation districts of California. The possible effects of these restrictions on consumer prices will be given special attention.

The Efficiency Costs of Strictly Enforcing the Reclamation Act

Because small farms require relatively more capital and labor to produce a dollar's worth of output than large farms, restricting farm size to the declining portion of the long-run average cost curve will increase the amount of resources used to produce food and fiber. These extra resources are misallocated in the sense that they have a higher opportunity cost in other activities; and, hence, restricting farm size will reduce overall economic productivity. This is the efficiency cost to be estimated for California under the Reclamation Act.

To estimate this cost, it is assumed that farm size will decline from an average of 2,500 acres to 320 acres in affected projects and that the new smaller farms will continue to produce the same crops in the same proportions as the 2,500 acre farms. The annual efficiency cost associated with this restriction on farm size is the difference in the production costs of the two-sized farms. Using the 1974 census data and assuming 30% of production in cotton; 30% in sugar, hay, and other field crops; 30% in vegetables; and 10% in cash grains, the costs of the 320-acre farm are estimated to be \$0.695 per dollar of sales. Using these same weights, the average Class-Ia farm of 985 irrigated acres is estimated to produce at a cost of \$0.652. This latter cost is adjusted down to \$0.649 to reflect the lower costs of a 2,500-acre farm. The adjustment is based on the synthetic firm analyses of several crops. Therefore, the restriction of farm size will increase costs \$0.046 per dollar of sales, or about \$27 per acre (based on average sales of \$600 per acre).

If the entire 1.1 million acres of excess land are subdivided into 320-acre farms, creating 3,000 new farm units, the overall annual efficiency costs would be about \$30 million. If another million acres were similarly subdivided because of the enforcement of the residency requirement, these costs would rise to \$57 million. However, there are at least three important reasons why these efficiency cost estimates should be considered upper bounds of the true efficiency costs of restricting farm size.

First, the true opportunity cost of unpaid operator labor may be lower than the $20,000 per year used in the above analysis. For example, if the true opportunity cost of this labor is $10,000 per year, then the efficiency cost estimates would be reduced 46% to $14.50 per acre and $16 million for the 1.1 million acres of excess land. Second, it should be recalled that one of the probable sources of large farm efficiency is access to high quality land. However, on the new 320-acre farms, land quality will be equivalent to that which now prevails on large farms making the productivity of these farms higher than is typical on similarly sized farms under current conditions; hence, the costs of the 320-acre farm actually may be lower than those implied by the census data. Third, the public and private institutions which constitute the farm support system, including input and service suppliers, Cooperative Extension, financial institutions, marketing firms, and government agencies and their related programs now geared toward the large farm, will have incentives to find cheaper ways of servicing the smaller units; and this may offset some of the current cost differential between the 320-acre and the 2,500-acre farms.

The Reclamation Act and Food Costs

Opponents of the strict enforcement of the Reclamation Act assert that food prices will rise to offset the higher production costs of the smaller farms. In order for there to be this second efficiency cost in the form of lost consumer surplus, there must be a reduction in total output of crops commonly grown in the affected projects. That is, the smaller farmers cannot simply pass on higher production costs because their output represents too small a portion of the overall market. If they attempt to raise their prices, they will lose their markets to other farmers. Only in the case of a few specialty crops, such as late winter fresh vegetables grown in Imperial County, is the share of total production sufficiently great to allow the farmer to pass on a small portion of his higher production costs resulting from restricted farm size.

Even though farmers are unable directly to pass on higher production costs, there are two possible reasons why crop prices might rise. First, if the 320-acre farm has lower output per acre, then farm-size restrictions may reduce total crop production and lead to higher prices. The 1974 census data indicate that yields of field crops (not vegetables) may be 10% lower on the 320-acre farm in comparison to the Class-Ia farm. However, a 10% reduction of field crops grown in California's reclamation projects will reduce national production by a fraction of a percentage point. If crop prices were to rise, farmers in other districts would increase their production, or government administrators would adjust acreage restrictions; and then increased production elsewhere would prevent significant price increases.

The second argument for higher crop prices is that the 320-acre farm is not economically viable, and enforcement of farm-size restrictions will drastically reduce the number of successful farmers and output, thus giving rise to higher prices. If the viability argument were true, it would still not necessarily imply higher prices for the reasons cited just above. However, the viability argument neglects the important role played by land values in determining the profitability of farms.

If farm-size restrictions lead to higher production costs, then, when land is sold to the new smaller farmers, they will take into account the lower income potential of the land and be unwilling to pay current land prices (which are established by the most productive farms). This point can be illustrated from the estimated rates of return on land derived from the 1974 census for different sized farms (table 3). The weighted average return on land in Class-Ia farms (based on the typical crop mix of farms in the affected projects) was approximately 17.5%, while it was 10.8% for the smaller 320-acre farms. These rates are probably considerably higher than normal, given the favorable crop prices of 1974. The important point is not the absolute level of profits but the relative advantage of the larger farms *vis-à-vis* 320-acre farms. If farm-size restrictions eliminate this advantage, then land values will decline, unless the new small farmers are content with much lower rates of return than larger farmers. For example, if land values declined 38%, the 320-acre farm would be as profitable as the average Class-Ia farm.

The strict enforcement of the Reclamation Act requires that land be sold to new farmers at a value not reflecting the benefits of federal water. In the Westlands Water District, land

Table 3. Rate of Return to Land by Farm Size, California, 1974

	Economic Class of Farms				
	Ia	Ib	II	III	IV
Census Classes	$100,000 and over	$40,000–$99,999	$20,000–$39,999	$10,000–$19,999	$5,000–$9,999
	%				
Cash grain farms	16.2	6.2	3.9	2.6	0.4
Sugar, hay, and other field crop farms	15.6	6.0	3.1	2.3	−2.0
Cotton farms	17.3	9.0	7.6	4.3	1.4
Vegetable farms	20.9	9.4	6.7	6.0	0.8
Fruit and nut farms	9.5	6.8	4.9	2.0	−0.9

Note: Estimates are derived by dividing profits (estimated from the cost data provided in table 2) by total land value. Land values have been modified to exclude the value of the farmer's home (estimated by deducting from total land value $30,000 for each farm operator reporting his farm as his place of residence).
Source: U. S. Bureau of the Census, *Census of Agriculture, 1974. Volume 1, California, State and County Data*, part 5, 1977, table 33.

with a market value of $1,500 is to be sold for $750. Therefore, even if the 320-acre farm is less efficient than the 2,500 acre farm, the access to land at such a low price should insure viable performance. In other affected projects, the "prewater" price of land has not been fixed; but even if the government does not attempt to set a low land value, land prices will decline to insure profitable farming opportunities.

The major impact of enforcing the acreage and residency provisions of the Reclamation Act will, therefore, be to reduce the wealth of the current landowner—whether or not he actually benefited from the windfall benefits created by the project. For example, if all 1.1 million acres of excess land were sold for half their market value, the wealth loss would amount to about $.5 billion. Some of this loss will become the gain of the new generation of owners; but because of increasing production costs in the reclamation projects, there will be a net wealth loss to the society. For example, if land values must fall 38% to maintain small farm viability, then 76% of the $1/2 billion wealth loss to current landowners will not be recovered by the new landowners. This wealth redistribution and loss may have some marginal implications for investor behavior and for the overall performance of the economy, but such effects are believed to be small.

Conclusion

In this paper we have surveyed three different bodies of evidence on cost-size relationships in California agriculture and have found a high degree of correspondence in their conclusions. The evidence shows that the long-run average cost curve is relatively flat after initially declining rapidly. The costs in the highly mechanized crops generally continue to decline slowly throughout the entire range of surveyed farm sizes; but in vegetable and fruit crops, costs do not appear to decline substantially after the initial phase of rapid decline. We also have examined the sources of declining production costs and conclude that, while there is a significant technical basis for these economies of size, other factors such as management, resource quality, and the overall institutional structure are even more important.

In analyzing the probable effects of the enforcement of the Reclamation Act in several regions of California, it has been argued that the smaller farms which would be established will have higher production costs; and these will give rise to resource misallocation and, hence, to an efficiency cost. However, it was also argued that food prices will not increase; rather, land values in reclamation projects may decline, causing substantial wealth losses to the current landowners.

Finally, this analysis has revealed the paucity of information and data sources which the economist can draw upon to explain the relation of cost to farm size. An extensive farm-level survey of production and market conditions of a wide variety of crops in California would supply the researcher with a sounder basis for analysis than aggregated census data or limited single-crop survey data. Further, there is a great need for empirical analysis of how factors—such as risk, product market structure and performance, labor supply and organization, and financial markets—discriminate against the small producer and how these factors can be adjusted to a more equitable basis without decreasing productive efficiency.

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An Approach to the Delineation of Rural Banking Markets

Stephen A. Mathis, Duane G. Harris, and Michael Boehlje

A cross-demand schedule approach is modified to develop a procedure for delineating product and service markets. Firms are classified as either rivals or nonrivals based on a statistical examination of response times to price adjustments. A test of the approach is made for the delineation of banking markets. Preliminary results indicate that the procedure may have potential for assisting policy makers in decisions regarding the competitive environment of the banking industry.

Key words: banking, delineation, markets, response time.

Increased demand by the farm production sector for capital and credit has stimulated renewed interest in the efficiency and performance of banking institutions serving agriculture. An analysis of the competitive environment in banking, the operational and allocational efficiency of the rural banking system, and policy prescriptions for structural change in the banking industry, however, cannot be made without accurate delineation of rural banking markets.

A market can be defined as the area encompassing all those economic units that exert and react to essentially the same set of competitive forces influencing the price and quality of a specific product or service. Such an area must be conceptually distinguished from a trade or service area. A trade area outlines the "potential customer area for a particular firm and is usually based on such characteristics as transportation costs, town size, or price differentials" (Huff, p. 38). As such, a trade area can be viewed as a subset within a market area. A market area will contain at least one, and often several, trade areas.

More than two decades ago, Papandreou and Wheeler outlined a procedure for market delineation that was based on cross-demand schedules between firms. They concluded that two products are substitutes and the firms producing those products are in the same market whenever the cross-demand curve for their products is positively sloped. If, however, the cross-demand curve between two firms is nonincreasing, the firms fall into separate markets. Glassman (p. 22), in an adaptation of the cross-demand schedule approach, defines a banking market as a "region in which the cross elasticity of demand for banking services between banks within the region is significantly higher than that existing between banks in the region and banks outside the region."

Cochrane criticized the Papandreou-Wheeler approach, however, as being operationally impossible to implement. He argued that the necessary price-quantity data to estimate cross-demand schedules do not exist. And even if the data were available, the cost of estimating cross-demand schedules between all firms would be prohibitive.

Since the Papandreou-Wheeler-Cochrane discussion of market delineation, several procedures have been proposed and used to delineate economic areas that are supposedly relevant to market analysis. Theoretical spatial configurations, as developed by Hyson and Hyson and Greenhut and Ohta, are analytically appealing but difficult to apply empirically to real world problems of market delineation. Techniques such as "customer spotting" and "license plate analysis" (Markin, pp. 195–96), and the "gravity approach," as developed by Reilly and modified by Converse and Huegy (pp. 388–94), are approaches that delineate trade areas rather than market areas. Political and other ad hoc boundaries such as city, county, or SMSA areas (Kaufman) have

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been widely used as proxies for market areas because of data availability. But such boundaries are arbitrary delineations usually resulting from political decisions made years ago and may have little to do with markets.

Thus, a desirable technique for market delineation would be one that incorporates the theoretical appeal of the cross-demand and cross elasticity approaches, avoids the arbitrariness of the ad hoc approaches, and offers the empirical applicability of the trade area techniques. The purpose of this paper is to present a delineation approach that attempts to satisfy these criteria.

First, the conceptual development of a general delineation procedure is presented, followed by a statistical adaptation of the procedure to the rural banking industry. An empirical example of the technique is reviewed and a summary and some conclusions are presented. Although the market delineation concepts developed in this paper are applied to rural banking, they should also be useful in analyses of the competitive structure, performance, and regulation of other agricultural input and commodity markets.

Conceptual and Empirical Basis for a Delineation Procedure

The theoretical base for the following delineation procedure is the interdependence among firm-pricing functions as suggested by Papandreou-Wheeler, Cochrane, and Glassman. Assume that two firms i and j operate either in an oligopoly setting in the same market or in separate markets. If the two firms are in the same market, the demand for services of one firm is dependent upon the price of those same services offered by the second firm. More specifically, if the cross elasticity, E_{ij}, approaches zero, firms i and j are in separate markets and thus are nonrivals. (Theoretically, the case of $E_{ij} = 0$, or no interdependence, could indicate the presence of either pure competition or isolated monopoly. The firm ignores its rivals, either because there are none as in the case of monopoly, or because the market is so atomistic that one firm has no bearing on the price and output of others in the industry, as is the case with pure competition. It is assumed that in banking, $E_{ij} = 0$ implies an isolated seller. It is likely that, because of restrictions on entry in rural banking, few cases of pure competition exist.) If, however, E_{ij} is greater than zero, then i and j are rivals in the same market.

Although cross-demand and cross elasticity are traditionally measured in quantity-price terms, it is possible to develop price reaction functions (dP_i/dP_j) in the cross-demand framework (Henderson and Quandt, pp. 225–27). The reaction function can then be used to measure the degree of price response of firm i to the pricing policies initiated by firm j. Theoretically, dP_i/dP_j will be either positive or zero, reflecting whether firms i and j are rivals or nonrivals, respectively.

The cross-demand, cross elasticity, and reaction function measures, however, are developed in a static context. It is assumed either that adjustments are instantaneous or that sufficient time is allowed to elapse such that a complete adjustment can occur. Realistically, where significant information and decision lags exist, a firm may make a series of adjustments in response to a rival's price change. These intermediate adjustment prices are not recognized in a static analysis. Consequently, an alternative measure of firm interdependence that is sensitive to dynamic price adjustments would be useful.

In a dynamic framework, the price reaction function can be evaluated by investigating the response time function dt_i/dP_j, where dt_i is the amount of time elapsed between any change in the price of firm i and a change in the price of firm j. The response time incorporates the use of all price adjustments, whether or not they are market clearing. Also, consideration is given to the timing of a price response.

In the absence of search costs and information or decision lags, response time will be either zero or infinite. If the two firms are rivals, one will respond immediately to a price action by the other—response time will be zero. If the two firms are nonrivals, firm i will never respond to price action by firm j—response time will be infinite.

Observed Versus Theoretical Response Times

Although the theory just elaborated implies that the response time of one firm to another will be either zero or infinite, in reality, it can be expected that response times will be nonzero but finite. For two rivals, price reactions may not be instantaneous because of information or decision lags. If firm i changes its price, it may be some time before firm j is aware of that change. Or, even if firm j immediately discovers the change in firm *i*'s pricing policy, the decision process may result in a delay before firm *j* can implement its own price changes. Thus, it is likely that for rivals, the response time will be nonzero.

Likewise, even for two nonrivals, it is unlikely that observed response time will be infinite. Firm *j* bases its pricing decisions on variables other than the price charged or offered by other firms. Even though firm *j* does not respond to firm *i*'s price, it may alter its price at some future date in response to other changing conditions. Thus, violation of *ceteris paribus* conditions will cause observed responses of nonrivals to be finite.

Because both rivals and nonrivals may exhibit nonzero, but finite, response times, it is necessary to develop an empirical procedure that can identify significant differences in finite response times. Standard statistical methods offer such a procedure.

Rationale for the Statistical Technique

The basic assumptions of the empirical market delineation procedure are that firms can be classified into two groups, rivals and nonrivals, and that the average response time between nonrivals is significantly greater than the average response time between rivals. For example, let x_R represent a sample of response times drawn from a response time population of rival firms. Then $\bar{x}_R$, the sample mean, is an estimate of the average response time for rival firms. Now let x_U represent a sample of response times drawn from two unclassified firms, and $\bar{x}_U$ the average response time of those firms. If $\bar{x}_U$ is significantly greater than $\bar{x}_R$, the two firms can be classified as nonrivals and be included in separate markets. If $\bar{x}_U$ is not significantly greater than $\bar{x}_R$, the two firms can be classified as rivals and be included in the same market.

The statistical adaptation also assumes that exogenous factors other than action by a competitor are randomly and identically distributed over both classes of firms. Differences in response times among rival firms which are used to generate the distribution of response times for rivals will be caused by changes in factors other than competitor prices. Those same "other factors" will impact unclassified firms as well. The statistical model assumes that the mean response time of rivals will be shorter than the mean response time of nonrivals. The effect of exogenous influences on response time will be reflected in the standard deviations of response times and thus become a part of the significance test.

Nonprice Competition

The theoretical model builds on the concepts of cross-price elasticity and price responses to delineate financial markets. However, in some sectors prices may be highly regulated and price competition virtually nonexistent. Yet implicit pricing or nonprice competition in the form of provision of other services may be readily apparent. In such environments, cross-price elasticity concepts provide limited assistance in market delineation.

One of the important attributes of the proposed delineation method is that it is consistent with the concepts of demand and price responses of competitors, yet sufficiently robust to encompass nonprice competition if empirical data or industry intelligence indicates that nonprice variables would provide a better indication of the competitive characteristics of a particular market. For example, in a highly regulated industry such as banking, a common response to a competitor's change in pricing policies is to add a new service. If such nonprice variables are included in the vector of variables that measure competitive response, the response time between changes in any price and/or nonprice variable can be measured. Then the same methodology and statistical procedures can be used to delineate markets.

So the procedure has a further appeal in addition to its theoretical base and modest data needs. It can be applied in a broad spectrum of market environments and is not exclusively dependent on the explicit pricing mechanism for empirical application. The key to using the methodology is the definition of the vector of variables and the changes in these variables that provide a legitimate measure of competitive response.

Application to the Banking Industry

The purpose of this section is to investigate the potential applicability of the delineation approach. To illustrate its potential and usefulness in the banking industry, a response variable must be chosen and various procedural assumptions specified. Although the response variable and assumptions utilized in this illustration do exhibit delineation capabilities, the purpose of this illustrative application is to evaluate the general approach, not to test the relative merits of alternative response variables or procedural assumptions. It is assumed in the following illustration that rural banking markets are local or regional in nature. The existence of the bank-customer relationship and transportation and communication costs are strong arguments in support of the assumption of the fragmentation of the banking industry into many separate markets. For other industry studies, it may be appropriate to consider regional and national markets. The delineation approach can be used regardless of the degree of market fragmentation in the industry. The scope of the market to be tested simply determines the extent of the data collection necessary for delineation.

Procedural Assumptions

To apply the empirical procedure to the delineation of rural banking markets, it is necessary to (*a*) identify a priori a sample of rival banks, (*b*) determine the appropriate variable for measurement of response times, and (*c*) select an appropriate statistical technique to test the significance of differences in response times.

The a priori sample of rival banks is defined to include banks located in the same town or city. It is presumed that, if two banks are located in the same town or city, they must have interdependent pricing functions. Because of their proximity, actions of one bank will affect the decisions of other banks in the city. Furthermore, it is presumed that response times between bank pairs in the same city can be pooled over different cities to generate the overall rival sample.

The best price variable for measurement of response times would involve a well-defined service that is homogeneous across banks. Time-deposit rates come the closest to satisfying that criterion. Homogeneity across banks is guaranteed by federal regulations pertaining to characteristics of time-deposit accounts. It is possible, of course, that markets defined by using time-deposit rates may be different from those that would be defined by using loan rates or other criteria.

Any statistical technique that evaluates the significance of differences in measures of central tendency is a candidate for use in the delineation procedure. The theory outlined above discussed differences in the mean response times of different classes of banks. However, because there is no information on the form of the underlying distributions of response time, it is most appropriate to use a nonparametric technique.

The nonparametric method used in this study to distinguish differences in mean response times tests for level (or location) differences between two populations and is referred to as the Wilcoxon-Mann-Whitney (WMW) test (Fryer, pp. 190–93). The WMW test normally is a one-tailed test with the hypotheses H_o: $[F(X_1) = G(X_2)]$ versus H_a: $[F(X_1) > G(X_2)]$ for all points along the X scale of measurement, where F and G are the cumulative distribution functions for X_1 and X_2 respectively. The test is based upon the general assumption that, if the magnitude of the size of X_1's is greater than the magnitude of the size of X_2's, and if one draws random samples x_1 and x_2 of sizes n_1 and n_2 from the X_1 and X_2 populations, respectively, the x_1's in the combined array of x_1's and x_2's should outrank the x_2's.

Specifically, one forms an ordered array for the combined samples of x_1's and x_2's and computes the variate:

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - T,$$

where T is the sum of the ranks of the x_1's in the combined array. The variable U has an approximately normal frequency distribution with a true mean of

$$\mu_U = \frac{n_1 n_2}{2},$$

and a true variance of

$$\sigma_U{}^2 = \frac{n_1 n_2(n_1 + n_2 + 1)}{12}.$$

Thus, the sampling variate

$$\lambda = \frac{U - (n_1 n_2/2)}{[(n_1 n_2)(n_1 + n_2 + 1)/12]}\ 1/2$$

has a $N(0, 1)$ frequency distribution, and H_o can be tested with the use of the cumulative standard normal distribution tables.

Research Design

Data on changes in time deposit rates during 1960–75 were collected from sixteen banks in Iowa. All banks are unit banks and none is associated with a holding company. Microdata from nine banks in four towns were used to generate the rival sample. The Kruskal-Wallis *H* test was conducted on the sample of rival banks to validate the assumption that response times among rivals can be pooled over different cities. The *H* test is a nonparametric procedure designed to test whether a collection of samples has been drawn from a common distribution (Wallis and Roberts, pp. 599–601). The results of this test showed that four of the six bank pairs initially chosen for the rival sample exhibited properties common to a single distribution. The remaining two bank pairs that did not demonstrate such properties were eliminated from the rival sample.

Data from seven additional unclassified banks in the area were used to test the delineation procedure. Two of the seven unclassified banks are located in a town of 3,200 people, and the other five are located in four towns ranging in size from 370 to 2,300 people. All the unclassified banks are located within a radius of fifteen miles.

A single-page mail survey with personal follow-up was used to collect date-of-change data from each bank. Although some banks expressed difficulty in completing the survey, others indicated that the data were readily available from minutes of board of directors' meetings or posting ledgers for active time-deposit accounts. Date-of-change information was requested for passbook, 3-, 6-, or 9-month certificates of deposit, 1-year certificates, 1–2½ year certificates and 2½–4-year certificates.

Calculation of Response Times

In determining the response times for the rival sample, the number of days that elapsed from the date of a rate change by the lead bank and a rate change in the same deposit category by the rival was calculated. Because interest rates were relatively stable prior to the 1960–75 period, any initial price changes in the sample were assumed to indicate lead bank price initiatives. The original lead banks, however, did not necessarily remain the price leaders throughout the time period. If the elapsed time exceeded 365 days, the response time was specified as 365 days, and any subsequent rate change by any rival bank was designated as a new lead. Only rate changes within the same deposit category were considered as legitimate responses. Furthermore, any rate change within the same category, even if rates were not equalized, was considered as a response.

Next, response times for the unclassified banks were determined. The response time for an unclassified bank pair was calculated as the elapsed time in days from date of change for the unclassified lead bank and the date of response by the other unclassified bank. Other rules for a legitimate response were the same as for the rival sample.

The response times for the unclassified banks are summarized in table 1. Because of

Table 1. Calculated Response Times for Unclassified Banks, in Days

C to (A or B)	D to (A or B)	(E or F) to (A or B)	G to (A or B)	C to D	C to G	C to (E or F)	D to (E or F)	G to (E or F)	D to G
365	365	365	365	365	0	6	365	0	0
122	365	365	365	365	365	72	365	365	0
365	18	40	365	365	365	365	365	365	14
137	365	23	12	365	365	160	51	20	31
12	365	33	365	31	0	20	9	0	73
365	365	365	365	0	0	0	0	365	357
51	13	365	365	365	365	11	365	365	365
63	12	365	365	319	37	365	5	365	365
31	365	174	365	6	19	10	20	365	365
7	365	365	59	19	62	40	365	0	
	365	8	365				9	365	
	365	34	365				0	365	
	192	365	26				365	9	
	13	365	185				365	82	
	12	365	60				5		
		365					20		
		40							
		194							
		33							

the 365-day rule and multiple responses to an initiative, the number of observations between unclassified banks are not the same for all bank pairs. All rival and unclassified banks used in this analysis offered the passbook and 1-year deposit instruments. All banks except bank C offered 3-, 6-, or 9-month certificates of deposit, so response times in this deposit category also were calculated where appropriate.

The Statistical Test

The WMW test was used to determine which of five surrounding unclassified banks are in the same market as the market center banks—banks A and B. Banks A and B were designated as the market center because the town in which they are located is the largest of the towns in the unclassified sample. Use of a market center is consistent with the procedure outlined by Cochrane.

Table 2 summarizes the calculated values for the WMW test for all pairs of unclassified banks or bank towns. Note that the tests are classified into two categories—a primary test and a secondary test. The primary test examines response times of unclassified banks to the lead bank in the market center. Thus, the primary test considers the reaction of banks C, D, E or F, and G to bank A or B. The secondary test examines response times among all other pairs of unclassified banks or bank towns. For example, the secondary test includes response times of banks C to D and D to E or F. Consistent with the concepts of market dynamics, the primary test considers the response to banks in the market center. The secondary test is a weaker test because it allows substantial delays in responses and the development of chains. Results of the secondary test are interpreted as providing additional evidence that two unclassified banks are in the same market, but cannot be used to disprove the results of the primary test. The calculated λ values for both the primary and secondary tests are summarized in figure 1.

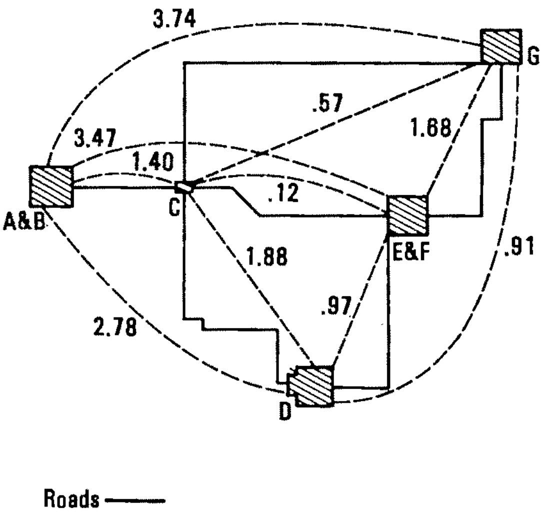

Figure 1. λ values for bank pairs

The statistical results of the primary test indicate that the response times of banks C, D, E or F, and G to banks A or B are significantly different, at the 10% level, from those of the rival sample. (To calculate response times of E or F to A or B, total days were measured from the lead date by one bank in a two-bank set to the first response by a bank in the other two-bank set.) Thus, these banks are not in the same market as A and B. In this example, the secondary tests are inconclusive with respect to whether banks C, D, E and F, and G are all in the same market. As mentioned previously, however, results of the secondary tests in no way affect the conclusions resulting from the primary test.

To obtain an estimate of the geographic boundaries of the market area, the results of the market area delineation could be integrated with delineations of trade areas. For example, market areas could be defined as the aggregation of trade areas for those banks identified as rivals by the delineation proce-

Table 2. Test Statistics for Illustrative Bank Market Delineation

	Primary Test				Secondary Test					
	C to (A or B)	D to (A or B)	(E or F) to (A or B)	G to (A or B)	C to D	C to G	C to (E or F)	D to (E or F)	G to (E or F)	D to G
T	386.5	641.0	851.5	700.0	379.5	317.0	296.0	573.5	532.0	297.5
U	168.5	184.0	201.5	125.0	145.5	208.0	229.0	314.5	281.0	170.5
λ_{cal}	1.40	2.78	3.47	3.74	1.88	.57	.12	.97	1.68	.91
$\lambda_{.10}$	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28	1.28

dure. The trade areas could be delineated by methods such as gravity models and license plate analysis.

Summary and Conclusions

The accurate delineation of product and service markets is an important aspect of the analysis of the competitive structure of an industry and of regulations to encourage competition in that industry. This paper presents an approach to the delineation of markets that is based on the cross-demand schedule procedure, is statistically adaptable to empirical use, and requires modest data.

The underlying theory establishes a two-category scheme for firm classification—rivals and nonrivals. Rivals are firms that respond to each other's pricing adjustments and are thus in the same market. Nonrivals are firms that do not respond to each other's pricing adjustments and are thus in separate markets. The statistical adaptation of the theory is based on the assumption that the response time of a firm to a nonrival's price change will be significantly greater than the response time of that same firm to a rival's price change. Preliminary empirical results indicate that the approach can be a useful aid in the delineation of rural banking markets. Thus, the technique may have potential for use in evaluating the existence of competition between or among banks, the competitive impact of regulatory change, and the effect on competition of proposed mergers.

The delineation procedure, however, is not without shortcomings. To use the procedure accurately, information on date-of-change in the appropriate response variable must be obtained. Such information may not be available in secondary data sources. In regulated industries such as banking, regulatory authorities could collect date-of-change data as part of their regular examinations. For other industries, personal interview or surveys may be required. However, the data needs of the methodology proposed here are modest in comparison to that required for the traditional cross-price elasticity approach.

In addition, the dates of price (rate) or nonprice changes for all firms (banks) must be obtained. For example, if rate change dates are missing or incomplete for one bank, it is impossible to determine in which market that bank belongs. Also, the test is strongest for confirming that two banks are in separate markets. Acceptance of the null hypothesis that response times for unclassified banks are not significantly different from those of rival banks does not necessarily mean that the unclassified banks are in the same market. However, acceptance of the alternative hypothesis that response times between unclassified banks are significantly different is a strong indication that the banks are not in the same market.

Furthermore, a market center must be specified to use as the base for the test. If this base is not used, elongated chains of rival banks may be identified (Cochrane, p. 26) and "gray areas" between well-defined market areas may arise.

The quantification of long delays or, essentially, nonresponses also presents difficulties. In this test of the approach, if a response did not occur within 365 days, the response time was specified as 365 days. A different rule for quantifying long delays may result in different numerical results. Also, only responses within the same deposit category were considered legitimate responses in this empirical test. If any change within the entire maturity structure was considered as a legitimate response, different results again might be obtained.

In applying the delineation procedure to the rural banking industry, our choice of the time deposit rate variable as the response measure may result in problems. Although time deposit categories are homogenous by law across banks, rates on time deposits also are highly regulated. In recent years, most banks have paid ceiling rates, and many banks have adjusted their rates when changes have been made in the ceiling regulations. These exogenous, artificial ceiling regulations not only may impede competition, but also may confound the measurement of competitive responses and delineation of bank markets. Thus, other response measures such as change in services or deposit maturities should be evaluated using the delineation methodology presented here.

Finally, our proposed methodology focuses only on the speed of response and ignores the extent of response. It is likely that the magnitude of response is an important factor in the dynamics of firm interaction. Additional work is necessary to incorporate response magnitude considerations. For example, it might be possible to convert each response into a "compound equivalent" where the compound equivalent is defined as the continuous rate of increase in the price variable necessary to achieve the actual change at the time of response. A larger response would result in a larger compound equivalent, and a longer delay in response would result in a smaller equivalent. Thus, the compound equivalent would capture the importance of both the magnitude and timing of responses and could be calculated and compared for rivals and unclassified firms.

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Food Delivery Programs and Other Factors Affecting Nutrient Intake of Children

David W. Price, Donald A. West, Genevieve E. Scheier, and Dorothy Z. Price

In a study of Washington state school children, regression models showed full participants in the school lunch program to have significantly higher intakes for five of ten nutrients than non- or partial participants. Nonparticipants had significantly higher intakes of iron. Nutrient intakes of food stamp recipients were not significantly higher than other school children. Liquid assets and total assets each increased intakes of two nutrients, while the value of food consumed had no significant effect on any of the nutrients. Biochemical data showed few problems of malnutrition to exist among this sample of school children.

Key words: assets, food stamp program, nutrient intake, school lunch program.

There is continuing concern over the cost and effectiveness of government food delivery programs. Eligibility criteria for food stamps are under review as attempts are made to reduce the cost of the program. School districts faced with reduced revenues may decrease support or terminate their school lunch programs. When these food programs are reviewed critically, one of the frequent recommendations for increasing their effectiveness is to distribute more equitably the benefits to persons with the greatest need. Unfortunately, the nutritionally needy groups in our society are not well identified and, more important, little is known about the impact of the food programs on nutrient intake. Policy makers need such knowledge in order to design and improve programs to make them more effective and efficient.

The research that has been done on impacts on nutrient intake is limited in program coverage and geographic scope. The results are valuable, however, because they identify some of the dimensions and complexities of the problem. The work of Madden and Yoder in two rural counties of Pennsylvania indicates that the diets of households who participated in commodity distribution programs (CD) were no more nutritious than diets of similar households not receiving commodities. Their results also indicate that food stamps provided some dietary improvement among households experiencing temporary shortages of funds, i.e., during periods more than two weeks after payday. A similar study by Lane in Kern County, California, indicated that use of food stamps resulted in significantly higher dietary levels of energy, protein, calcium, thiamin, and riboflavin by participants as compared with nonparticipants. These improvements were observed among subsets of the sample but were not consistent across the sample as a whole.

This paper adds to the knowledge of food program effectiveness by reporting the results of a comprehensive study of the programs conducted in the state of Washington. In the study, relationships between dietary status and relevant socioeconomic variables, including participation in the Food Stamp (FSP) and National School Lunch (NSLP) and Breakfast Programs, were explored using a sample of

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728 school-aged children. Regression models were specified to estimate the net effect of participation in food delivery programs on intakes of selected nutrients.

The Sample

The sample included 728 school children aged eight to twelve years attending public schools in the state of Washington. There were 194 Mexican-Americans, 218 black, and 316 white children. Data were collected during the spring of the 1971–72 school year and throughout the 1972–73 school year. This number differs from numbers used in other aspects of the overall study (West and Price) in two respects: children from the single nonparticipating district were excluded from this analysis; additionally, there were not complete data sets on all subjects, which means that the number of observations will vary with the variables used in the analysis.

The sample used a two-stage cluster design based on clusters within school districts and within individual schools. Individual school districts were selected by stratifying for both district size and geographic area within the state. Individual districts within areas and district size categories and individual schools within districts were selected by probability sampling with higher probabilities given in each case to those with large enrollments of black and Mexican-American children.

The sampling goal was to obtain equal numbers of black, white, and Mexican-American children. Within each ethnic group, the sampling procedure was designed to obtain equal numbers of children above and below the 125% poverty level and within each of these six cells to obtain equal numbers of children participating and not participating in the NSLP. To accomplish the sampling goals, twelve lists of students were compiled in each school and random samples of children were drawn from each list. Due to scarcity of children with relevant characteristics in some of the cells, equal cell numbers were not obtained. When the sample was completed, 42% were children receiving free NSLP lunches. Eighteen percent participated in the NSLP zero to one time per week and 19% participated two to three times per week.

Considerable care was exercised in collecting data. Nutrient intakes were calculated from three separate twenty-four-hour recalls obtained from each child. The interviews were spaced to collect one recall for a weekend day and two for weekdays. Different weeks of the month were represented for each child. Prior to the two weekday recalls, the interviewers recorded what the child ate at the noon meal in school. Representative portions of the foods served were weighed and the amounts traded or wasted were recorded. Thus, the noon meals at school were actual consumption and not recall data. Polaroid photographs of the lunch were used by research support personnel as reference points for the identification and quantification of foods served. Each interviewer used up to thirty food and beverage models to estimate more accurately the amounts of each food or beverage consumed. Previous studies by Madden, Goodman, and Guthrie and by Greger and Etnyre show potential errors in recalling amounts of certain types of foods. However, it is not known whether these limitations exist for this study. Data on socioeconomic characteristics of households containing the children were collected through personal interviews. Personal interviews also were used to collect information on frequency of serving different foods and on food preferences of the children. (Further details on the sampling procedure and the interview procedures are given in Price et al.)

Specification of Variables

Ten separate regression models were specified to explain nutrient intake, one for energy and one for each of the nine indicator nutrients (see appendix). Separate specification for each nutrient is necessary since excess consumption of one nutrient does not compensate for deficiencies in another. The dependent variables include intakes from vitamin and mineral supplements.

Independent variables hypothesized to influence nutrient intake were anthropometric measurements of the child, participation in government nutrition programs, economic characteristics of households, food patterns and preferences, and geographic variables. The empirical variables used in the models appear in the appendix. A more detailed listing is available from the authors on request. The anthropometric measurements of the child—age, sex, height, and weight—determine the child's recommended dietary allowance (RDA) (age and sex only) as well as reflect physical development (height and weight relative to age). Younger children usually eat less than older ones, females usually eat less than comparable males, and smaller children generally eat less than larger ones.

The relationship between nutrient intake and weight (as a percentage of standard for age and for height) is not as obvious. Analysis with Automatic Interaction Detector (A.I.D.) showed that children with weights at 100–139% of the standard for their age and height had higher intakes of some nutrients than children weighing less than 100% of standard or more than 139% of standard (Sonquist, Baker, Morgan).

Participation in the national school lunch or breakfast program was expected to increase intakes of most nutrients because, if totally consumed, these meals will provide at least one-third of the RDA for most nutrients. The alternative to these meals may or may not be planned to provide specific nutrients. In some cases a meal is not provided.

It was hypothesized that children who go to school without breakfast have lower intakes of the nutrients usually provided in substantial amounts by breakfasts commonly eaten by eight- to twelve-year-old children. Since the nutrient composition of a typical breakfast differs from that of lunch or dinner, proportions of certain nutrients consumed vary according to whether or not the child had eaten breakfast.

Three economic variables—dollar value of food obtained, value of liquid assets and of total assets—measure the ability of the household to purchase a nutritionally adequate diet for their children. The value of food obtained measures food purchases as well as food obtained through home production, gifts, and other sources. Current income was not specified as a separate variable because its impact is reflected through food expenditures. Value of food and income are related in this sample (West and Price). The value of liquid assets and total assets were included as measures of the household's ability to provide food when income is periodically low. Under normal income and expenditure patterns a household may spend a sufficient amount on food to provide an adequate diet. But if there are no cash reserves when short-run financial difficulties arise, the household diet may suffer. Liquid assets provide a direct source of funds to purchase food when such situations occur. Total assets are a proxy for the borrowing power of a household.

Other household characteristics hypothesized to affect nutrient intake are ethnic status, household size, and the occupation and education of the adults. Tastes and preferences vary among ethnic groups and they are passed on to children from their parents. Earlier work by West and Price shows that value of food obtained per adult equivalent decreases as household size increases. This relationship suggests that type of food consumed and, therefore, nutrient intake may also vary with household size. Occupation of the major income earner represents the group with which the major income earner likely socializes and it can represent the amount of physical activity of the major income earner. Preliminary analysis showed only the armed forces to be related to nutrient intake. Education of the female adult serves as a proxy for nutritional knowledge. Years of education was assumed to be directly associated with nutritional knowledge and a more balanced diet for the child.

This survey contained selected information about household food patterns. Specifically included were frequencies of serving major food categories including fruits, vegetables, milk, and meat, poultry, or fish. The frequency of serving foods in a particular category was included in that model where the category was an important source for the nutrient being analyzed. Also included in the survey was information on whether the household served specific foods at least every two weeks. To reduce the large number of foods to a few variables, a factor analysis was conducted on these data. One factor, selected frozen vegetables, was identified to be important for the nutrient models.

The use of vitamin supplements has a direct impact on the intake of those nutrients contained in the supplements. Moreover, their use may reflect an increased concern on the part of parents for their children's nutritional well-being. The taking of two types of supplements, multiple and vitamin C, were identified as separate variables.

To identify preferences of the individual, three food preference schedules were administered to each child. The schedules were fruits and vegetables (twenty-one items), milk products (seventeen items), and common school lunch foods (twenty items). Children placed the food items in each schedule in five categories ranked from least to most liked. Scores of one to five were assigned. From these scores and from the nutrient content of a typical serving of each food, a food preference index for each nutrient was constructed. Preliminary analyses showed these preference indices to be important for only protein and calcium. A second variable was constructed from the food preferences schedules—number of foods a child is unwilling to try. The child was instructed to select all food items he or she was unwilling to try in the two most disliked categories. The number of foods from the three schedules was summed.

The final category of variables identified the geographic origin of the adults in the household and their location within Washington. Studies by Burk have shown that the demand for food varies by region and is influenced by weather and custom. Three variables were introduced to identify this: (*a*) geographic area where the person primarily responsible for food preparation was raised, (*b*) degree of urbanization where the household was residing, and (*c*) location of that residence within Washington.

Procedures

All variables hypothesized to affect the respective nutrient intakes were included in regression models. These variables were also subjected to the University of Michigan's Automatic Interaction Detector (A.I.D.). The regression analysis was used to ascertain statistical significance of the explanatory variables. The A.I.D. analysis was used to identify important interactions and nonlinearities in the explanatory variables. The A.I.D. analysis used only discrete explanatory variables. Continuous variables are broken down into discrete categories. (For example, one source of a nonlinearity appears when categories with values near the mean of the explanatory variables have means of the dependent variable higher than those of other categories.) The residuals from the regression analysis were also subjected to A.I.D. analysis. Important interactions and nonlinearities that appeared were incorporated into the regression analysis (see Barrows and Bromley for an application of this procedure). The final model does not include any interactions because those identified by A.I.D. had low *t* values. Nonlinearities identified by A.I.D. and included in the final model are designated by ^{d} in table 1.

Variables with strong theoretical bases were retained in the regression models even though they had *t* values less than 1.64. These included (*a*) age and sex of the child; (*b*) two coefficients for variables representing small cities in eastern Washington (*t* value = 1.60); (*c*) one coefficient on NSLP participation (*t* value = 1.46).

Results

As expected, intakes of all nutrients increased with age (table 1). Variations in the responsiveness of nutrient intake differed, with the elasticity for vitamin A being the smallest and that for vitamin C being the largest. Thus, nutrient compostion of the diet changes as the child grows older. Females had lower intakes of all nutrients than did males except for vitamin C. The results indicate that diets of females have a different nutrient composition than that of males.

Larger children, as measured by height, have higher intakes of calcium and phosphorus than smaller children. Other intakes were higher for larger children but not significantly higher at the .10 level. The child whose weight was between 100% and 139% of standard for age had higher intakes of energy and protein than other children.

Children who were full participants in the school lunch program had higher intakes for five of the ten nutrients. Milk is a good source for three of these nutrients, which suggests milk consumption is higher among full participants than among partial or nonparticipants. Energy and thiamin intakes were lower among partial participants than non- or full participants. The reason is not obvious. The coefficient for iron intakes was higher for nonparticipants; however, the *t* value was less than 1.64. By itself, this gives little credence to the conclusion that nonparticipants have higher iron intakes. However, an earlier model was run using children from a nonparticipating district, which increased the number of nonparticipants by 121 children. The coefficient for nonparticipants was positive and had a *t* value of 3.4.

Eleven percent of the children in the sample came to school without breakfast. By weighting various subparts of the sample, we estimate that 7% of the white, 12% of the black, and 13% of the Mexican-American children in Washington go to school without breakfast. Intakes of four nutrients were lower for those children who did not eat breakfast (table 1). Milk is a good source for all four nutrients.

Only twenty children in the sample participated in the school breakfast program four to five times per week. The intake of vitamin C was 42% higher for these breakfast participants. Thus, there is some evidence that the breakfast program is an effective instrument for increasing nutrient intake. In 7–13% of the cases, the school breakfast did not replace a meal furnished by parents (as is the usual case for the lunch). Rather, it supplied a meal where none existed.

Children who took multiple vitamins had higher intakes of all nutrients (table 1). For iron and the five vitamins, this would be expected since the dietary supplements were included as part of the intakes. The higher intakes for the other four nutrients indicate that taking vitamin supplements measures the mother's concern for the nutritional well-being of the child.

Intakes of all ten nutrients were higher for children in households whose major income earner was in the armed forces. The explanation for this is not clear. The amount of organized physical activities or the eating habits developed by the adults eating in mess halls may be carried over into the home and may affect the nutrient intake of the children.

Liquid assets increased the intake of calcium and phosphorus and total assets increased the intake of riboflavin and vitamin C. The effects of total and liquid assets combined with the lack of an effect of monetary value of food are similar to findings of Madden and Yoder which indicate that the length of time since receiving income affects intake. The intakes that are affected by liquid and total assets are associated with the consumption of milk and fresh fruit. These items are perishable and are likely to be unavailable to the household when cash reserves are low.

The coefficients on monetary value of food obtained were not significant at the 10% level. The lack of a relationship between nutrient intake and monetary value of food may be a phenomenon found only in areas where there is a substantial "floor" under income. In April 1972 the AFDC payments per recipient ranged from $14.73 to $77.20 among the fifty states, with the average at $52.16. Payments in the state of Washington were $63.43 per recipient, which reduced observations of households with extremely low incomes.

West and Price have shown that for this sample there is some relationship between income and monetary value of food but the income elasticity is only .04. One would expect a higher income elasticity of demand for the services and luxury aspects embodied in purchased food items than in the inherent nutrient content of foods. In the income range represented by this sample, higher income does not lead to higher intake of nutrients but to a substitution of more prepared or luxury foods, e.g., steaks versus hamburger. One should note that this contrasts with the findings of Adrian and Daniel who, with 1965 U.S. data, showed that the intake of some nutrients are significantly related to current income.

An earlier study using the same data also showed that participation in the food stamp programs increases the value of food consumed (West and Price). Since liquid and total assets did affect some intakes through cash reserves, there remains the question of whether or not food stamps remedy the cash reserve limitations on food purchases. Most food stamp recipients in this sample were purchasing food stamps monthly. The money management practices that lead to lower intakes because of lack of cash at the end of a pay period likely lead to a lack of food stamps toward the end of the month. To validate this, a dummy variable for food stamp recipients was included in the nutrient intake models. The coefficients were both positive and negative but none were statistically significant. Therefore, for the state of Washington during the 1972–73 period, little relationship existed between the receipt of food stamps and nutrient intake of school children.

The frequency of serving meat in the household increased intakes of energy, protein, and niacin. The frequency of serving milk to adults of the household increased intakes of calcium and phosphorus. The frequency of serving juice increased the level of dietary vitamin C. The frozen vegetable factor (cauliflower, spinach, broccoli, and brussel sprouts) increased intakes of vitamin A and vitamin C. Three of these vegetables are excellent sources of vitamin A (cauliflower is not) and all supply vitamin C in substantial quantities.

White children had higher intakes of the three milk-related nutrients (calcium, phosphorus, and riboflavin) than blacks or Mexican-Americans. Mexican-American children had lower intakes than whites or blacks of two meat-related nutrients (thiamin and niacin). Intakes of calcium, vitamin A, and vitamin C were lower for children whose mothers had education levels of less than nine

Table 1. Relationship of Nutrient Intake of Washington School-aged Children to Explanatory Variables

Independent Variables	Energy	Protein	Calcium	Phosphorus	Iron	Vit. A	Thiamin	Riboflavin	Niacin	Vit. C	Cell Count for Dummy Variables
	Elasticities for Continuous Variables—Percentage of Change in Dependent Variable per Unit Change in Explanatory Variable for Discrete Variable[a]										
Age child	.5347 (7.45)[c]	.4047 (5.29)	.3439 (3.32)	.2910 (4.74)	.3891 (3.91)	.1357 (.77)	.2406 (1.69)	.3561 (3.09)	.3776 (3.18)	.7157 (2.90)	
Sex female	−0.656 (3.68)	−.0701 (3.75)	−.0689 (2.70)	−.0648 (3.21)	−.0881 (3.54)	−.0633 (1.44)	−.1059 (2.98)	−.0799 (2.75)	−.0818 (2.74)	.0515 (.83)	359
Height (% of standard)	—	—	.4096 (1.72)	.2939 (2.12)	—	—	—	—	—	—	
Weight (100–139% of standard)[d]	.0365 (2.01)	.0397 (2.08)	—	—	—	—	—	—	—	—	435
Lunch participation (4–5 times per week)	—	.0524 (2.62)	.1024 (3.69)	.0626 (2.84)	—	.1309 (2.78)	—	.0789 (2.47)	—	—	460
Lunch participation (2–3 times per week)	−.0473 (2.10)	—	—	—	—	—	−.1156 (2.56)	—	—	—	140
Lunch participation (0–1 times per week)	—	—	—	—	.0491 (1.46)	—	—	—	—	—	128
Breakfast participation (4–5 times per week)	—	—	—	—	—	—	—	—	—	.4225 (2.23)	20
No breakfast	—	—	−.0668 (1.68)	−.0558 (1.72)	—	—	−.1202 (2.11)	−.0909 (1.96)	—	—	80
Household size	—	−.0537 (2.02)	—	—	—	−.1964 (3.00)	−.1298 (2.36)	−.1058 (2.42)	−.0875 (1.91)	—	
Occupation—Armed Forces	.1396 (4.68)	.1017 (3.14)	.1407 (3.11)	.0826 (2.39)	.1040 (2.45)	.2082 (2.76)	.2748 (4.36)	.2794 (5.52)	.2114 (4.27)	.2213 (2.12)	75
Liquid assets (per adult equivalent)	—	—	.0262 (1.81)	.0185 (1.68)	—	—	—	—	—	—	
Total assets[d] (per adult equivalent)	—	—	—	—	—	—	—	.0976[b] (2.57)	—	.1981[b] (2.54)	
Ethnic group—white	—	—	.0952 (3.02)	.0527 (2.20)	—	—	—	.0861 (2.48)	—	—	316
Mexican-American	—	—	—	—	—	—	.1734 (3.51)	—	−.1023 (2.66)	—	194
Education of adult female (<9 years)[e]	—	—	.0913 (2.45)	—	—	−.1781 (3.15)	—	—	—	−.1626 (2.12)	182
Freq. serving meat[d]	.0718 (2.56)	.0789 (2.66)	—	—	—	—	—	—	.0737[c] (1.71)	—	
Freq. serving milk	—	—	.0505 (2.61)	.0310 (2.02)	—	—	—	—	—	—	
Freq. serving juice	—	—	—	—	—	—	—	—	—	.0873 (1.66)	
Frozen vegetable factor	—	—	—	—	—	.0579 (2.78)	—	—	—	.0673 (2.30)	
Takes multiple vitamins	.1053 (3.96)	.1202 (4.29)	.1254 (4.01)	.1378 (4.57)	.2327 (6.27)	.3693 (5.63)	.5827 (10.94)	.4384 (10.10)	.4329 (9.71)	.4846 (5.23)	94
Takes vitamin C	—	—	—	—	—	—	—	—	—	.6852 (3.80)	22
Food preference value for protein	—	.5123 (2.56)	—	—	—	—	—	—	—	—	
Food preference value for calcium	—	—	.8379 (2.64)	—	—	—	—	—	—	—	
Number of foods unwilling to try—9 or more[d]	—	—	—	—	—	.0777	—	—	—	—	

						(1.77)					
Urban area (50,000 + pop.)	—	—	−.0737 (2.36)	—	—	—	−.1134 (2.37)	—	—	—	341
Small city (10,000–50,000 pop.)	—	—	—	—	—	—	—	.0744 (1.99)	—	—	143
Origin: South	−.0712 (3.59)	−.0705 (3.37)	−.1118 (3.44)	−.0782 (3.04)	—	—	—	−.0873 (2.35)	—	—	203
Northwest & Central	—	—	—	—	—	.1448 (2.29)	—	—	.0912 (2.12)	—	105
Western Wash.—rural	—	—	—	—	—	—	.2297 (3.28)	—	—	—	57
Eastern Wash.—urban	−.1239 (2.71)	−.1140 (2.36)	—	−.1480 (2.85)	—	−.2646 (2.33)	−.2609 (2.76)	—	−.2618 (3.38)	−.2953 (1.84)	29
Eastern Wash.—small city	−.0766 (2.16)	−.0636 (1.70)	—	−.0639 (1.60)	—	−.1501 (1.73)	−.1699 (2.29)	—	−.1346 (2.29)	−.1965 (1.60)	50
Columbia Basin	.0938 (3.16)	.1099 (3.49)	—	—	.1396 (3.39)	—	—	—	—	—	77
R^2	.187	.166	.184	.154	.114	.146	.248	.231	.224	.130	

[a] *T*-values in parentheses.

[b] Dummy variable for total assets greater than $6,500 included.

[c] Dummy variable for frequency of serving meat less than twenty times per month included.

[d] Nonlinearities identified with AID.

years. Education was correlated with being Mexican-American (r = .69), which causes uncertainty as to whether the lower intakes can be attributed to low education levels or to food patterns of Mexican-Americans.

Children in larger households had lower intakes of several nutrients, five of which had statistically significant coefficients at the .05 level. Four of the five were vitamins. This indicates differing food patterns for large households. They consist of smaller proportions of fresh fruits and vegetables, meat, and milk.

Children of parents raised in the southern United States (including Texas) had significantly lower intakes of five of the nutrients. Parents of southern origin were predominantly blacks from southeastern areas and Mexican-Americans from the lower Rio Grande Valley of Texas. These lower intakes indicate different food consumption patterns by children whose parents were raised in the South. Four of the five nutrients can be related to milk consumption. These results are consistent with the 1965 USDA Household Food Consumption Survey which shows lower milk and dairy product consumption in the South than in the West.

Comparison of Nutrient Levels to Standards

The discussion to this point has centered around variables that affect levels of nutrient intake. Comparison of absolute levels of nutrients, both actual and predicted, with standards for intake is needed to assess the nutritional well being of this sample. Sample means of intakes as a percentage of RDA for all three ethnic groups are shown in table 2. The source for the RDA was the Food and Nutrition Board, 1974 revision.

For whites the average intake was 99% or more of RDA for every nutrient except energy. Energy intakes are usually low with 24-hour recalls because the respondent fails to recall some of the energy sources such as snack items and food accompaniments. Averages for blacks were mostly 99% or more with the additional exception of calcium. Among Mexican-Americans, average intake was less than 90% for calcium, thiamin, and niacin, as well as for energy. The RDA is a standard set sufficiently high that individual or group averages slightly below 100% of RDA are of little concern. Some nutritionists consider group averages of two-thirds of RDA or less to be at risk of malnutrition for some nutrients. The specific percentage varies by nutrient and by nutritionist.

There is considerable variation in the amount of nutrients which may be adequate for persons of the same age and sex. Therefore, it is not possible to tell from these data whether serious problems of malnutrition exist for specific individuals. The standard deviations of the various intakes are large relative to the size of the intakes, so that the nutrient intakes by some children appear to be quite low. However, these data came from only three days of food consumption. Single day intakes may be considerably lower or higher than the long-run intake. Thus, the 24-hour recall is a useful measure for groups but not individuals. Consequently, analysis of risk of malnutrition must be made on a case-by-case basis. Analysis of biochemical parameters for this same sample, however, indicates that the risk of malnutrition was quite low and that widespread problems of malnutrition did not exist among eight- to twelve-year-old children in the state of Washington (see Price et al., chap. 4).

Table 2. Nutrient Intakes as a Percentage of RDA—Ethnic Group Means and Profiles

Group/Profile	Energy	Protein	Calcium	Phosphorus	Iron	Vitamin A	Thiamin	Riboflavin	Niacin	Vitamin C
White	79.6	178.4	103.8	132.7	99.8	132.8	111.1	168.8	100.7	200.6
	(17.7)	(46.5)	(36.1)	(40.4)	(42.2)	(78.3)	(63.5)	(66.6)	(43.5)	(193.7)
Black	77.0	170.4	89.7	123.3	99.3	144.6	105.0	155.7	101.0	202.1
	(20.7)	(45.1)	(38.0)	(39.9)	(41.3)	(98.0)	(57.2)	(76.7)	(46.5)	(148.0)
Mexican-American	76.0	167.4	81.5	116.5	91.1	98.7	88.6	131.9	83.1	150.0
	(20.2)	(47.4)	(31.9)	(36.6)	(40.0)	(61.8)	(39.3)	(54.1)	(34.3)	(115.5)
Profile #1	71.3	172.1	120.2	145.7	98.1	158.6	105.5	182.0	89.3	225.2
Profile #2	62.5	134.5	58.7	100.4	103.8	80.5	65.0	98.1	66.1	112.0
Profile #3	65.6	152.2	83.0	121.9	98.1	114.8	77.6	125.9	73.3	154.8
Profile #4	68.2	154.4	95.9	123.9	103.8	124.3	92.8	154.4	82.0	182.4

Note: Standard deviations of intake as percentage of RDA are given in parentheses.

In order to evaluate the degree to which the explanatory variables can affect intake as a percentage of standard, nutrient intakes were projected from the regression models and compared to RDA for various types of children (table 2). The first group of variables are eating patterns which a household could undertake to improve the nutrient intake of the child, with the exception of taking vitamin supplements. The second set describes the socioeconomic profile of the household. All profiles are for a nine-year-old female, weight less than 100% of standard, not participating in the school breakfast program, not taking vitamin supplements, residing in western Washington or the Yakima Valley in a town of 10,000–50,000 population, whose parents were raised in the western United States and are not members of the armed forces. All other variables are held at their means.

Profile number one describes a child with the best nutritional and socioeconomic background possible out of this set. Profile number two describes the poorest. Profile number three describes a child in a household with a socioeconomic background leading to low intake, but with good nutritional habits. The fourth profile is a child in a household with an adequate level of socioeconomic variables but poor nutritional habits. The variables defining the difference between good and poor nutritional background are school lunch participation (full versus non-), eating breakfast (yes versus no), the frequency of serving meat, milk, and juice (30, 60, 30 versus 15, 15, 10 times per month, respectively), and the frozen vegetable factor score (1.0 versus 0.0). The variables defining the difference between good as against poor socioeconomic background are ethnic group (white versus Mexican-American), household size (4 versus 8), geographic origin (West versus South), education of the adult female (9 or more versus 9 or fewer years), liquid assets ($200 versus $0), and total assets (more than $6,500 versus less than $6,500).

For profile number two, the intakes of energy, calcium, thiamin, and niacin are below 70% of RDA, With the exception of energy, none of the other profiles show any intakes below 70% of RDA. Thus, it takes a combination of the poorest possible circumstances to obtain intakes below 70% of RDA. Calcium, phosphorus, vitamin A, thiamin, riboflavin, and vitamin C are more sensitive to changes in the profile variables than are the other nutrients examined.

Summary and Implications

Participation in the national school lunch program increased the intakes of five of ten nutrients among public school students in Washington. The school breakfast program significantly increased intakes of vitamin C. The breakfast program has particular potential for increasing intakes among participants since it has been estimated that more than 7% of the eight- to twelve-year-old children in Washington state go to school without breakfast.

Among economic variables, the value of total assets and liquid assets owned by the household affected intakes of some nutrients. Both asset variables represent the potential for obtaining cash to purchase food when current income is low or when the household is facing economic contingencies. In contrast, food expenditures did not have a significant effect on children's nutrient intake. The Food Stamp Program, designed to increase nutrient intake by increasing ability to purchase food, also had little effect on the intakes of nutrients for this sample of school children. This may be due to relatively high AFDC payments in Washington, placing a relatively high floor under income.

Possible interactions between the FSP and school feeding programs may contribute to the lack of a positive influence of the FSP. Almost all children coming from households receiving food stamps in this study also participated in the school lunch program. Thus, inferences could differ for persons not taking part in school feeding programs.

If the lack of influence of food stamps holds for all members of a household, the difference between the school breakfast and lunch programs and the food stamp program has important implications for the design of feeding programs. The school feeding programs are professionally planned to contain at least one-third of the child's RDA for many nutrients. In contrast, the mix of food items purchased with food stamps is left to the discretion of the household member who purchases food.

The analysis of biochemical data showed few problems of malnutrition existing among this sample of eight- to twelve-year-olds. The ability to purchase adequate food may be attributable to incomes supported by relatively high AFDC payments. If there are no nutritional benefits from food stamps in states with high AFDC payments, the benefits of the program relative to the receipt of cash can be questioned. Neoclassical consumption theory states that consumers can increase utility by having free choice. Thus, many food stamp recipients could increase utility by decreasing the amount spent on food. Increasing the levels of intake appears to require not only the ability to purchase food but also the knowledge and willingness to obtain the "mix" of food items that provide proper nutrition. For this sample the argument that increases in purchasing power, such as those provided by the Food Stamp Program, alone will improve nutritional well-being does not hold. However, the possible interaction among the FSP and the school feeding programs should be kept in mind. Further work is needed to assess empirically the impact of "in-kind" versus cash transfers on nutrient intake for all groups.

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Appendix

Indicator Nutrients and Variables Affecting Intake

A. Nutrients (Dependent Variables):

1. Energy	6. Vitamin A
2. Protein	7. Thiamin
3. Calcium	8. Riboflavin
4. Phosphorus	9. Niacin
5. Iron	10. Vitamin C

B. Independent Variables:
1. Age, sex, height, and weight of child (height and weight measured as percentage of standard for age, height, and sex, respectively)
2. Participation in Government Nutrition Programs:
    a) "Type A" school lunch; full (4–5 times/week), partial (2–3 times/week)
    b) School breakfast; full or none
    c) No breakfast (at home or school)
3. Economic Characteristics of Households:
    a) Value of food obtained per adult equivalent
    b) Value of assets owned by household; liquid and total
    c) Ethnic status; black, Mexican-American, or white
    d) Household size; number of persons
    e) Education of female adult; number of years
    f) Occupation of major income earners; Armed Forces and other
4. Food Patterns and Preferences:
    a) Frequency of serving foods in household: meats, juices, or milk
    b) Selected frozen vegetables (factor)
    c) Child taking vitamin supplements: multiple or vitamin C
    d) Food preference indices for child; protein or calcium
    e) Number of foods the child was unwilling to try
5. Geographic Variables:
    a) Geographic origin of household adult preparing food
    b) Population density of residential area; metro, small city, or other
    c) Geographic area within Washington

The Expected Utility Hypothesis and Demand-Supply Restrictions

Rulon D. Pope

The implications of expected utility theory are examined in order to determine restrictions relevant to reduced form econometric models. In general, Hicksian certainty restrictions do not hold under risk aversion. However, under output price uncertainty, the qualitative nature of the Hicksian restrictions are generally preserved for a commonly used class of polynomial utility functions. These and additional restrictions are considered in the context of a linear model amenable to econometric analysis.

Key words: demand-supply restrictions, econometric models, risk.

Recently, it has become fashionable to devise tests for determining the efficiency of economic agents. Given that one wishes some notion of the behavioral model describing firms' actions, the accompanying tests for economic efficiency seem to fall into three categories: (*a*) test whether value of the marginal product equals factor cost (or other similar conditions) based upon econometric models of the competitive profit-maximizing firm, e.g., Hoch and Wolgin; (*b*) test whether predictions derived from normative programming models are "sufficiently" close to observed decisions via χ^2 or other statistical measures, e.g., Lin, Dean, and Moore; (*c*) test for symmetry, homogeneity, and positive semidefiniteness in reduced form econometric equations as implied by competitive profit-maximizing behavior, e.g., Court and Woods.

These methodologies are well known for the risk-neutral case. However, for many sectors of the economy, risk and risk aversion appear to be stylized facts. The effects of utilizing (*a*) under risk aversion for various specifications have been described by Wolgin, Dillon and Anderson, Pope and Just, and are prevalent in development and agricultural research. Risk efficiency analysis via (*b*) has been considered by numerous authors primarily in a quadratic programming context, e.g., Lin, Dean, Moore. However, it would appear that no deductive (or empirical) work has been directed toward the implications of risk utilizing the approach described in (*c*). Such is the concern here: the implications of risk-averse and risk-neutral theories are contrasted with an aim to ascertain whether feasible econometric restrictions appear under risk aversion.

It is determined that risk aversion (under output price risk) implies that input demand functions are not homogeneous of degree zero (or any degree) if the argument of utility is nominal wealth or income and the utility function is nonhomothetic; thus, risk-averse behavior implies rejection of the homogeneity restriction. Also, generally input demand and output supply symmetries are not indicated, and the implications of risk-averse behavior are empirically intractable. However, for a commonly used class of polynomial utility functions, the qualitative nature of the Hicksian certainty positive semidefinite and symmetry restrictions hold. Hence, when there is divergence from the symmetry relationship, this implies rejection of both expected profit and expected utility maximization for this class of utility functions. Alternatively, acceptance of risk neutrality based on symmetry may be unwarranted. Given the growing interest in and evidence of risk response (e.g., Just and Pope, and Behrman), these results should be helpful for understanding the implications of risk theory in econometric modeling of risk response.

Setting

Attempts to test economic efficiency have focused either on the dichotomous issue, "Are

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decisions efficient?" or perhaps on the more interesting question, "Is one set of economic agents more efficient than another set?" The discussion here will focus for simplicity on the former question in a particular way: (*a*) the null hypothesis of profit maximization is assumed to be tested; or (*b*) the hypothesis of expected utility maximization is to be tested. The restrictions implied by (*a*) will be reviewed for completeness, but restrictions for (*b*) must be derived. Emphasis will be placed on econometrically feasible restrictions, but we shall not focus on econometric technique or other empirical difficulties not directly of concern to this initial inquiry. Further, we shall assume that a contingent claims market is not well developed for the commodity considered and, hence, risk is unavoidable when production is positive. Though any number of random specifications can be studied, for expositional simplicity, a single output price uncertain firm will be considered. For purposes of this paper, it appears to be unnecessary to investigate the effects of uncertainty in its most general context with multiproducts and both production and price uncertainty. For practical and expositional convenience, some narrowing of the uncertain environment is needed. It would seem that output price uncertainty would be of predominant interest given recent market events and the public interest elicited. Further, as Hartman has indicated, it is crucial to the results whether it is assumed that all decisions are made prior to the realization of particular "draws" of the random environment. For short-run agricultural decisions (such as appropriate crop mix), it would seem "almost" realistic to assume that all decisions are made before the realization of prices; such is the rationale and assumption made here.

In accordance with the above comments, a single-product, price-uncertain firm in a static model will be explored. Though many possible functional forms (e.g., polynomial or log linear forms) for demand and supply functions could be considered, in keeping with recent empirical risk-response models (Just 1976, Ryan) when specific examples of general results are presented, the linear case only will be considered. Hopefully, this inquiry will be helpful in posing econometric restrictions in future work—whether such studies involve linearity and output price risk or more general economic structures. Even in the linear single product case, the major difficulties of risk-averse specifications are evident. Finally, the multiproduct case is examined in an example to illustrate the results for a class of utility functions.

In concluding this section, it should be noted that both (*a*) and (*c*) can be considered as parts of a single econometric test of efficiency. However, in practice (*c*) is applied to the reduced-form system to avoid complications of estimating production functions and/or incurring simultaneous equation bias inherent in the estimation of structural equations.

Expected Profit Restrictions

There are two methodologies one may employ to derive the restrictions: obtain the restrictions by directly differentiating marginal conditions, or apply the primal-dual envelope scheme of Samuelson (p. 34) and Silberberg. All of the results of this paper can be obtained in a manner similar to Hicks by differentiating marginal conditions with respect to all parameters. Though these calculations are cumbersome, they do yield explicit comparative static results and expressions indicating homogeneity of demands and supplies. However, as indicated by Silberberg, all comparative static and symmetry conditions can be derived by the positive semidefiniteness restrictions on the primal-dual Lagrangean function. This will provide a convenient approach for this paper.

Consider the primal-dual problem,

$$L^* = \bar{\pi}^* - \bar{\pi}, \tag{1}$$

where $\bar{\pi}^*$ and $\bar{\pi}$ are the indirect and direct expected profit functions, respectively. Here the direct and indirect functions have conventional meanings with the indirect profit function containing only parameters as arguments (i.e., optimal input quantities are solved and inserted in the profit function). Profit is denoted by

$$\begin{aligned}\pi &= Pq - \sum_{j=1}^{M} c_j X_j,\\ &= Pq - cX\\ P &= \bar{P} + \epsilon \quad \text{with} \quad E(\epsilon) = 0,\end{aligned}$$

where it is assumed that $q = F(X)$ denotes the production function with q as output and X is a vector of input levels, P is the price of output distributed with mean $\bar{P}$, c denotes the input price vector, and the transpose operator is taken as understood. Hence, the indirect expected profit function may be written as $\bar{\pi}^*$ ($\bar{P}$,

c). (Though fixed inputs could also be considered, no additional insights are gained.) The primal-dual scheme indicates that the marginal conditions (2)–(4) describe the optimum $X = X^*$, $q = q^*$:

$$(2)\qquad \frac{\partial L^*}{\partial X_j} = -\bar{\pi}_{X_j} = 0 \qquad \text{(for all } j\text{)},$$

$$(3)\qquad \frac{\partial L^*}{\partial \bar{P}} = \bar{\pi}^*_{\bar{P}} - \bar{\pi}_{\bar{P}} = 0,$$

$$(4)\qquad \frac{\partial L^*}{\partial c_j} = \bar{\pi}^*_{c_j} - \bar{\pi}_{c_j} = 0 \qquad \text{(for all } j\text{)},$$

where subscripts (other than on X and c) denote derivatives. Since $\partial\bar{\pi}/\partial\bar{P} = q^*$ and $\partial\bar{\pi}/\partial c_j = -X^*_j$, (3) and (4) can be rewritten as

$$(3')\qquad \bar{\pi}^*_{\bar{P}} = q^*$$

$$(4')\qquad \bar{\pi}^*_{c_j} = -X^*_j,$$

where * denotes indirect or optimal quantities. (3′) and (4′) are known variously as Shepard's, Hotelling's, or the McFadden (Shepard)-Uzawa lemmas, which have been used extensively in empirical work. With slight modification, these duality results apply to multiproduct formulations as well. (Several efficiency studies have utilized duality because of its elegance and econometric convenience, e.g., Lau and Yotopolous). However, the real point of interest here involves the implications of the convexity of L^*, i.e., L^* must be positive semidefinite, (Silberberg, p. 162). For the present problem considered, this implies that the matrix

$$(5)\qquad L^*_{\alpha\alpha} = \begin{bmatrix} L^*_{\bar{P}\bar{P}} & L^*_{\bar{P}c} & L^*_{\bar{P}\tau} \\ L^*_{c\bar{P}} & L^*_{cc} & L^*_{c\tau} \\ L^*_{\tau\bar{P}} & L^*_{\tau c} & L^*_{\tau\tau} \end{bmatrix}$$

must be positive semidefinite, i.e., all principal minors must be nonnegative. $L^*_{\alpha\alpha}$ consists of typical elements,

$$(6)\qquad L^*_{\alpha_k\alpha_{k'}} = \bar{\pi}^*_{\alpha_k\alpha_{k'}} - \bar{\pi}_{\alpha_k\alpha_{k'}},$$

where $\alpha_k(\alpha_{k'})$ denotes the kth (k'th) parameter of the set $\alpha = (\bar{P}, \tau, c)$ and τ consists of other moments (than $\bar{P}$) of the distribution of P (under risk neutrality, L^*_τ should be zero). Silberberg has shown that (6) is equivalent to

$$(7)\qquad L^*_{\alpha_k\alpha_{k'}} = \sum_{j=1}^{M} \frac{\partial\bar{\pi}_{\alpha_k}}{\partial X_j} \frac{\partial X^*_j}{\partial \alpha_{k'}}$$

$$= \sum_{j=1}^{M} \left\{ \frac{\partial^2 \text{(direct objective function)}}{\partial\alpha_k\, \partial X_j} \right\} \frac{\partial X^*_j}{\partial\alpha_{k'}}.$$

Equation (7) is often more convenient for our purposes. Applying (7) to (3) and (4) yields the four elements of the upper left-hand corner of (5) explicitly:

$$\tilde{L}^*_{\alpha\alpha} = \begin{bmatrix} \partial q^*/\partial\bar{P} & \partial q^*/\partial c_1 \cdots & \partial q^*/\partial c_M \\ -\partial X^*_1/\partial\bar{P} & -\partial X^*_1/\partial c_1 & \vdots \\ -\partial X^*_M/\partial\bar{P} \cdots & \ddots & -\partial X^*_M/\partial c_M \end{bmatrix}.$$

Here, it is clear that positive semidefiniteness implies diagonal elements are nonnegative or,

$$(8)\qquad \partial q^*/\partial\bar{P} \geq 0, \qquad \text{and}$$

$$(9)\qquad \partial X^*_j/\partial c_j \leq 0$$

for all j.

Positive semidefiniteness also implies determinental restrictions. However, all inequality restrictions and particularly those of matricial form are impossible to handle without a nonlinear programming approach to estimation. Hence, such restrictions will not be of interest here. However, by the symmetry of $L^*_{\alpha\alpha}$, we add

$$(10)\qquad \partial X^*_j/\partial\bar{P} = -\partial q^*/\partial c_j, \quad \text{and}$$

$$(11)\qquad \partial X^*_k/\partial c_j = \partial X^*_j/\partial c_k$$

for all j and k.

These results hold regardless of whether production is joint or constrained by fixity of some inputs. Further, utilizing (2), (10), and (11), it is easy to show that output supply and input demand functions are homogeneous of degree zero (see Hicks or appendix 1). Thus, homogeneity implies

$$(12)\qquad \bar{P}\,\partial q^*/\partial\bar{P} + \sum_j c_j\,\partial q^*/\partial c_j = 0$$

for the supply function, or

$$(13)\qquad \bar{P}\,\partial X^*_j/\partial\bar{P} + \sum_j c_j\,\partial X^*_j/\partial c_j = 0$$

for the demand function.

Thus, pragmatic reduced form restrictions (8)–(11) for the linear system (ignoring error terms) are

$$(14)\qquad \left[\begin{array}{c} q^* \\ \hline X^* \end{array}\right] = \left[\begin{array}{c|c} \underset{1\times 1}{A_1} & \underset{1\times M}{A_2} \\ \hline \underset{M\times 1}{A_3} & \underset{M\times M}{A_4} \end{array}\right] \left[\begin{array}{c} \bar{P} \\ \hline c \end{array}\right] = [A] \left[\begin{array}{c} \bar{P} \\ \hline c \end{array}\right],$$

where (8′) $A_1 \geq 0$, (9′) diagonal elements of A_4 are nonpositive, (10′) $A_3 = -A_2$, (11′) A_4 is symmetric, and (12′), (13′) $[A] \left[\begin{array}{c} \bar{P} \\ \hline c \end{array}\right] = 0.$ Notice that (14), (12′), and (13′) indicate a basic inconsistency when using linear forms. The inconsistency disappears under more general forms such as log linear demand and supply functions. The above set of restrictions may be imposed; or, alternatively, the hypothesis of profit-maximization may be tested by likelihood ratio or other tests. There are numerous ways that these tests could be conducted, but the least cumbersome appears to be the familiar likelihood ratio test when normality may be assumed (see Court and Woods for details). We turn now to similar restrictions under expected utility maximization.

Expected Utility Restrictions

Corresponding to (1) is the primal-dual function under expected utility maximization, or

$$L^* = E[U(\pi^*)] - E[U(\pi)],$$

where as earlier π^* and π denote the indirect and direct profit functions, respectively. However, optimal decisions are now with respect to the expected utility function: that is, $\pi^* = \pi^* (\bar{P}, c, \tau, \epsilon)$. Corresponding to (2)–(4) are:

$$(15) \qquad L^*_{Xj} = -E[U'(\pi)\, \pi_{X_j}], = 0,$$

$$(16) \quad L^*_{\bar{P}} = E[U_{\bar{P}}(\pi^*)] - q^*\, E[U'(\pi)] = 0, \quad \text{and}$$

$$(17) \quad L^*_{c_j} = E[U_{c_j}(\pi^*)] + X^*_j\, E[U'(\pi)] = 0.$$

It can be verified using (7), (16), (17), and positive semidefiniteness of $L^*_{\alpha\alpha}$ that

$$(18) \quad L^*_{\bar{P}\bar{P}} = q^* \sum_{j=1}^{M} E[U''(\pi)\pi_j]\, \partial X^*_j/\partial \bar{P} + E[U'(\pi)]\partial q^*/\partial \bar{P} \geq 0, \quad \text{and}$$

$$(19) \quad L^*_{c_jc_j} = -X^*_j \sum_{k=1}^{M} E[U''(\pi)\pi_k]\, \partial X^*_k/\partial c_k - E[U'(\pi)]\, \partial X^*_j/\partial c_j \geq 0,$$

where $U'(\pi) = dU/d\pi$ and $U''(\pi) = d^2U/d\pi^2$ and, e.g., $\pi_j = \partial\pi/\partial X_j$. However, it is noted that (18) and (19) do not imply $\partial q^*/\partial \bar{P} \geq 0$ and $\partial X^*_j/\partial c_j \leq 0$ under risk aversion $[U''(\pi) < 0]$. We generally expect such results to be observed; indeed, Sandmo has shown $\partial q^*/\partial \bar{P} > 0$ under decreasing absolute risk aversion (which appears to be a very mild restriction). No simple intuitive restrictions have been derived, such that factor demand curves under risk aversion have nonpositive slopes. However, for the two, input case results can be obtained (see Batra and Ullah).

Since $L^*_{\alpha\alpha}$ is symmetric, the following conditions corresponding to (11) are obtained under risk aversion:

$$(20) \qquad L^*_{c_jc_k} = L^*_{c_kc_j}, \text{ or}$$

$$X^*_k \sum_{s=1}^{M} E[U''(\pi)\pi_s(\partial X^*_s/\partial c_j)] + E[U'(\pi)](\partial X^*_k/\partial c_j) = X^*_j \sum_{s=1}^{M} E[U''(\pi)\pi_s(\partial X^*_s/\partial c_k)] + E[U'(\pi)](X^*_j/\partial c_k).$$

However, (20) does not generally imply that $\partial X^*_j/\partial c_k = \partial X^*_k/\partial c_j$. Similarly, by examining $L^*_{\bar{P}c_k}$ and $L^*_{c_k\bar{P}}$, it can be verified that $\partial X^*_k/\partial \bar{P} \neq -\partial q^*/\partial c_k$ and hence, in general, homogeneity of supply and demands is violated (see appendix 1). Therefore, without further assumptions, all of the restrictions given in (8)–(13) do not hold under risk aversion. When risk preferences are linear, $U''(\pi) = 0$, and it is seen from (16)–(20), and (27) that all of conditions (8)–(13) do hold, i.e., the risk-neutral case is obtained.

A Decreasing Risk Averse Example

The above results are indicated with a decreasing risk-averse homothetic utility function,

$$(21) \qquad U(\pi) = \pi^{\alpha}$$

with $1 > \alpha > 0$ (Pratt). It is shown in appendix 2 that the application of (21) in (18)–(20) gives respectively,

$$(18') \quad [q^*K + \alpha E(\pi^{\alpha-1})](\partial q^*/\partial \bar{P}) \geq 0,$$

$$(19') \quad [-X^*_jK\partial q^*/\partial c_j] - [\alpha E(\pi^{\alpha-1})\partial X^*_j/\partial c_j] \geq 0,$$

$$(20') \quad X^*_kK(\partial q^*/\partial c_j) + \alpha E(\pi^{\alpha-1})(\partial X^*_k/\partial c_j) = X^*_jK(\partial q^*/\partial c_k) + \alpha E(\pi^{\alpha-1})(\partial X^*_j/\partial c_k),$$

where $K, \alpha, E(\pi^{\alpha-1}) > 0$. Hence, (18′) implies (ignoring the possibility of equality) an upward sloping supply curve. However, (19′) does not imply negatively sloped factor demand curves (inferiority, $\partial q^*/\partial c_j > 0$, implies $\partial X^*_j/\partial c_j < 0$; however, this seems like an uninteresting implication). Finally, since

$X^*_k(\partial q^*/\partial c_j)$ does not in general equal $X^*_j(\partial q^*/\partial c_k)$, then (20′) does not imply that $\partial X^*_k/\partial c_j = \partial X^*_j/\partial c_k$. It also can be verified, as noted earlier, that $\partial X^*_j/\partial \bar{P} \neq -\partial q^*/\partial c_j$.

Restrictions for a Class of Utility Functions

It may appear here that risk aversion implies no empirically useful and simple restrictions. Indeed, such may be the case for many utility functions. However, for the class of decision functions indicated by (22), the certainty results are intact. Let

$$(22) \qquad E[U(\pi)] = \bar{\pi} + \sum_{t=2}^{T} a_t\sigma_t, \\ = \bar{\pi} + Z(\sigma), \sigma = (\sigma_2, \ldots, \sigma_T),$$

where σ_t represents the tth central moment of profit and a_t is a constant (Z need not be linear but could represent any function of the central moments of π). Farrar and others have justified (22) on the basis of a Taylor's series expansion of utility at $\bar{\pi}$ of order T. The utility function in (22) is commonly used in financial theory, e.g., Markowitz. Also, note that Freund's familiar negative exponential utility function (under normality) is a member of (22), since the decision function is

$$(23) \quad \bar{\pi} + a_2\sigma_2 \\ a_2 < 0, \text{ with, and } \quad \sigma_2 = E[\pi - \bar{\pi}]^2.$$

If c_j's are fixed, then σ_t is not a function of c_j; and employing (7), it is verified that $\partial E[U(\pi)]/\partial c_j = -X^*_j$ and $L^*_{c_jc_k} = L^*_{c_kc_j}$, or $\partial X^*_j/\partial c_k = \partial X^*_k/\partial c_j$. It also may be reasonable to suppose that σ_t is not a function of $\bar{P}$, i.e., given the stochastic specification of price, both the mean and variance (or other moments) of price may move independently of each other. For example, σ_2 in (23) is $q^2V(\epsilon)$, where V denotes variance. Hence, from (22), it can be verified using (7) that $\partial q/\partial c_k = -\partial X^*_k/\partial \bar{P}$. (The only condition needed here is that $Z_{\bar{P}} = \partial Z/\partial \bar{P} = 0$: an anonymous referee has suggested that Z be more generally interpreted as any location invariant parameter of the distribution of π.) It further can be shown that these results hold in the multiproduct case where all output prices are random. Further, by positive semidefiniteness, $L^*_{\bar{P}\bar{P}}, L^*_{c_jc_j} \geq 0$. Therefore, using (7) and (22), $\partial E[U(\pi)]/\partial \bar{P} = q^*$ and $\partial E[U(\pi)]/\partial c_j = -X^*_j$, and hence, $L^*_{\bar{P}\bar{P}} = \partial q^*/\partial \bar{P} \geq 0$ and $L^*_{c_jc_j} = -\partial X^*_j/\partial c_j \geq 0$. That is, the qualitative nature of comparative static results is similar to the risk neutral case—demand curves are downward sloping and supply curves upward sloping. However, as shown in appendix 1, if utility functions are defined on money income and nonhomothetic ($a_t \neq 0$), then input demand and output supply functions are not homogeneous of degree zero. Since many empirical utility functions, e.g., (22), exhibit money illusion, it is not a matter of indifference whether real or nominal prices are used in empirical analysis as is the case under certainty or risk neutrality. If money illusion seems unreasonable and is not to be tested, then functions such as (22) should be defined over real income. However, it is not implausible that enlarging profits by a constant factor would alter decisions as the "scale of the bet" is larger.

In summary, given the polynomial preference function in (22), the restrictions given in (8)–(11) also apply under risk aversion. This is so because $\partial E[U(\pi)]/\partial \bar{P}$ is equal to q^*, and $\partial E[U(\pi)]/\partial c_j$ equals $-X^*_j$. The homogeneity restrictions may or may not hold depending on the specification.

It should also be noted that when a particular utility function is used, such as (23), then further implications of expected utility maximization may be obtained. For example, (23) implies, by the symmetry of $L^*_{\alpha\alpha}$, that $L^*_{V(P)a_2} = L^*_{a_2V(P)}$, or $a_2\ \partial q^*/\partial a_2 = V(P)\ \partial q^*/\partial V(P)$. Though one is unlikely to have ready information on a_2, estimates of $\partial q/\partial V(P)$ and $V(P)$ may be obtained and hence estimates of $a_2\partial q^*/\partial a_2$ obtained as well; that is, there is a sort of symmetry between the effects of increased risk and risk aversion on output supplies. For example, Just's (1974) supply-response model gives subjective estimates for $V(P)$ and $\partial q^*/\partial V(P)$ when output is a dependent variable. Further $L^*_{V(P)c_j} = L^*_{c_jV(P)}$ or, $2a_2q^*\partial q^*/\partial c_j = -\partial X^*_j/\partial V(P)$, and similarly, $\partial q^*(\partial q^*/\partial \bar{P})V(P) = \partial q^*/\partial a_2$ for $L^*_{a_2\bar{P}} = L^*_{\bar{P}a_2}$. Thus, an alternative estimator of the effects of risk aversion (a_2) may be obtained. Further restrictions may be derived for the multiproduct case where covariances enter the decision function.

A Multiproduct Example

The results derived above are for the special case of a single-product, price-uncertain firm. As is apparent, much production is multiproduct and joint in nature. Further, production uncertainty is also prevalent. In this penultimate section we wish, for expositional purposes, to explore an example which illustrates the results of this paper yet is simple and useful. So as to simplify the exposition, the multiproduct price-uncertain case will be considered. This should enable the interested reader to catch the spirit of the approach and pursue more complicated analyses when motivated by studies involving risky production as well.

In this example, a model analogous to those employed in risk-response studies (e.g., Just 1976, and Behrman) will be considered. The production function will be written implicitly as $F(q_1, \ldots, q_i, \ldots, q_N, X_1, \ldots, X_j, \ldots, X_M; W) = 0$, where the q_i are outputs, X_j are inputs, and W are fixed inputs. Profits for this problem are given by $\pi = \sum_{i=1}^{N} P_i q_i - \sum_{j=1}^{M} c_j X_j$, where P_i is the ith output price and c_j is the jth input price. L^* for this case, assuming the utility function in (23) is

$$\bar{\pi}^* + a_2 \sigma^*_2 - (\pi + a_2 \sigma_2) - \lambda F; \qquad a_2 < 0, \tag{24}$$

where λ is a Lagrangean multiplier, σ_2 is variance of profits, and * denotes the indirect utility function. The existence of the constraint F implies that (7) must be modified to add on the right-hand side $+ \lambda \sum_{j=1}^{M} F_{\alpha_k X_k}\, \partial X^*_j/\partial \alpha_{k'} + F_{\alpha_k}\, \partial \lambda^*/\partial \alpha_{k'}$. However, $F_{\alpha_k}\ (\alpha_k \neq W) = 0$, i.e., all parameters other than W will not affect the calculations of $L^*_{\alpha\alpha}$, and hence, for factor prices and expected output prices, (7) is appropriate (Silberberg). Since F is not a function of c_j and $\bar{P}_i$, we obtain, using (7), the following restrictions:

$$L^*_{c_j c_j} = \frac{\partial X^*_j}{\partial c_j} \leq 0, \tag{25}$$

$$L^*_{\bar{P}_i \bar{P}_i} = \frac{\partial q^*_i}{\partial \bar{P}_i} \geq 0,$$

$$L^*_{\bar{P}_i c_j} = L^*_{c_j \bar{P}_i} \text{ implies } \frac{\partial q^*_i}{\partial c_j} = -\frac{\partial X^*_j}{\partial \bar{P}_i},$$

$$L^*_{c_j c_s} = L^*_{c_s c_j} \text{ implies } \frac{\partial X^*_j}{\partial c_s} = \frac{\partial X^*_s}{\partial c_j}, \text{ and}$$

$$L^*_{\bar{P}_i \bar{P}_k} = L^*_{\bar{P}_k \bar{P}_i} \text{ implies } \frac{\partial q^*_i}{\partial \bar{P}_k} = \frac{\partial q^*_k}{\partial \bar{P}_i}.$$

Finally, assume independence such that variance of profits can be written $V(\pi) = \sigma_2 = \sum_i q^{*2}_i \sigma_{P_i}$, where σ_{P_i} denotes the variance of the ith price. Given this assumption, $L^*_{\sigma_{P_i} \sigma_{P_i}} = 2a_2 q^*_i\, \partial q^*_i/\partial \sigma_{P_i} \geq 0$. Since $a_2 < 0$ and $q^*_i \geq 0$, this restriction implies

$$\partial q^*_i/\partial \sigma_{P_i} \leq 0, \tag{26}$$

i.e., an increase in variance, *ceteris paribus*, leads to decreased supply. In a linear system, augmenting (14), the system of demand and supply equations is given by

$$\begin{bmatrix} \underset{N \times 1}{q^*} \\ \hline \underset{M \times 1}{X^*} \end{bmatrix} = \left[\begin{array}{c|c|c} \underset{N \times N}{A_1} & \underset{N \times M}{A_2} & \underset{N \times N}{A_5} \\ \hline \underset{M \times N}{A_3} & \underset{M \times M}{A_4} & \underset{M \times N}{A_6} \end{array}\right] \begin{bmatrix} \bar{P} \\ \hline c \\ \hline \Sigma \end{bmatrix}, \tag{27}$$

where Σ denotes the vector of price variances. Equations (25) and (26) imply the following econometric restrictions: diagonal elements of A_1 are nonnegative, diagonal elements of A_4 are nonpositive, $A_3 = -A_2$, A_1 is symmetric, A_4 is symmetric, and diagonal elements of A_5 are nonpositive. There are other restrictions implied by the theory, as well; however, these usually involve sample values and, hence, are of less use for econometric work. For example, $L^*_{\bar{P}_i \sigma_{P_i}} = L^*_{\sigma_{P_i} \bar{P}_i}$ implies that $\partial q^*_i/\partial \sigma_{P_j} = 2a_2\, q^*_j\, \partial q^*_j/\partial \bar{P}_i$, i.e., risk aversion ($a_2$) equals $A_5^{ij}/(2q^*_j A_2^{ji})$, where A_5^{ij} is the $i-j$th element of A_5. Further elaborations on the above model and set of restrictions can easily be obtained by the methodology used above, i.e., examining the implications of the symmetry and positive definiteness of $L^*_{\alpha\alpha}$.

Summary and Conclusions

Risk considerably complicates matters as to testable restrictions implied by the expected utility hypothesis. In empirical applications where expected profit maximization is the null hypothesis [with restrictions implied by (8)–(13)], one may not expect all of the restrictions to hold (Court and Woods rejected the hypothesis of profit maximization). There are many possible reasons for such a finding: one explored here is that risk aversion may be present. It seems intuitively clear, for example, that output supply symmetrics based on expected prices may not be observed because a risk averter considers also the risk reduction (or gain) from altering the level of an activity.

However, even when the restrictions appear to hold in risk-neutral models, the analysis of (22) indicates that similar comparative static and symmetry results are obtained in the risk-averse case. The homogeneity restriction alone may differentiate the two models on the basis of price related restrictions. What is clear is that risk aversion may prevail, as for polynomial utility functions given in (22); and yet, one may observe behavior similar in some respects (the restrictions) to risk-neutral behavior. For such functions, the effects of variance of price and other such factors may be utilized in reduced form tests, or one may wish to test whether the value of the marginal product $\gtreqless$ input price. However, given that input demand and output supply functions are often of ancillary, if not prime, interest, the reduced form tests appear to have merit. Finally, as in demand analyses, even if behavioral hypotheses are not tested, the imposed restrictions aid in identification and estimation (e.g., Cournot, Engel, and Slutsky symmetry restrictions in demand analyses, Phlips). Though many practical difficulties are inherent in any empirical application or test of a behavioral hypothesis, it is hoped that this work has contributed towards initiation of risk response in a formal manner into reduced form models.

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Appendix 1

Homogeneity

The proposition that the supply function is homogeneous of degree zero is often established under certainty by illustrating that marginal conditions for the firm are invariant for proportional price changes or that the profit function changes proportionally. Clearly if U is homothetic, then demands and supplies may be homogeneous. Suppose $U(k\pi) = \phi(k)U(\pi)$, where k and $\phi(k) > 0$. Hence, $E[U(k\pi)] = \phi(k)E[U(\pi)]$, and maximization of expected utility is invariant to the scale of prices (no money illusion). However, most empirical work is based upon utility functions of the form in (22). Hence, it seems fruitful to investigate the implications of inflation and other conditions on demands and supplies. A brief review of the certainty results will be helpful. However, here an Euler equation will be examined.

Supply function risk neutrality. Because $\bar{P}(\partial q/\partial \bar{P}) = \sum_{j=1}^{M} \bar{P}F_j\,(\partial X_j/\partial \bar{P})$, and $\bar{P}F_j = c_j$, from first order conditions we obtain

$$\text{(A.1)}\qquad \bar{P}(\partial q/\partial \bar{P}) = \sum_{j=1} c_j(\partial X_j/\partial \bar{P}).$$

From (10), $\partial q/\partial c_j = -\partial X_j/\partial \bar{P}$ and hence, utilizing (A.1),

$$\text{(A.2)}\qquad \bar{P}(\partial q/\partial \bar{P}) + \sum_{j=1}^{M} c_j(\partial q/\partial c_j) = \bar{P}\sum_{j=1}^{M} F_j(\partial X_j/\partial \bar{P}) - \bar{P}\sum_{j} F_j(\partial X_j/\partial \bar{P}) = 0.$$

Input demand functions (risk neutrality). From (10), $\bar{P}\partial X_j/\partial \bar{P} = -\bar{P}\partial q/\partial c_j$. By symmetry, $\partial X_j/\partial c_k = \partial X_k/\partial c_j$, and $\sum_{j=1}^{M} c_j(\partial X_j/\partial c_j) = \sum_{j=1}^{M} c_k\partial X_k/\partial c_j$. Thus,

$$\begin{aligned}\text{(A.3)}\qquad \bar{P}(\partial X_k/\partial \bar{P}) + \sum_{j=1}^{M} c_j(\partial X_k/\partial c_j) &= -\bar{P}\partial q/\partial c_k + \sum_{j=1}^{M} c_j(\partial X_j/\partial c_k)\\ &= -\bar{P}\partial q/\partial c_k + \bar{P}\sum_{j=1}^{M} F_j(\partial X_j/\partial c_k)\\ &= -\bar{P}(\partial q/\partial c_k) + \bar{P}(\partial q/\partial c_k) = 0,\end{aligned}$$

where the first equality follows from $\partial X_k/\partial c_j = \partial X_j/\partial c_k$, the second from (2), where $\bar{P}F_j = c_j$, and the third from $\partial q/\partial c_k = \sum_{j=1}^{M} F_j(\partial X_j/\partial c_k)$.

Supply function (risk aversion). First order conditions for the risk-averse firm are

$$\text{(A.4)}\qquad E[U'(\pi)(PF_j - c_j)] = 0 \qquad \text{for all } j, \text{ or}$$

$$\text{(A.5)}\qquad \bar{P}F_j + F_j\frac{\text{Cov}\,[U'(\pi), P]}{E[U'(\pi)]} = c_j \qquad \text{for all } j.$$

Throughout the derivation, it will be convenient to use the utility function in (22) since symmetry conditions do hold. In this case, (A.5) becomes

$$\text{(A.6)}\qquad \bar{P}F_j + Z_j = c_j.$$

Thus, corresponding to (A.1), we obtain

$$\text{(A.7)}\qquad \bar{P}(\partial q/\partial \bar{P}) = \sum_{j} (c_j - Z_j)\partial X_j/\partial \bar{P},$$

and corresponding to (A.2) is

$$\text{(A.8)}\qquad \bar{P}(\partial q/\partial \bar{P}) + \sum_{j=1}^{M} c_j(\partial q/\partial c_j) = \sum_{j} (c_j - Z_j)\,\partial X_j/\partial \bar{P} - \sum_{j=1}^{M} c_j\partial X_j/\partial \bar{P} = -\sum_{j=1}^{M} Z_j(\partial X_j/\partial \bar{P})$$

$\neq$ a constant or, in particular, 0. Given the utility function in (23), it can be shown that a proportionate increase in prices implies a reduction in output supplied, *ceteris paribus*.

Input demand functions (risk aversion). Because symmetry conditions hold given (22), then $\bar{P}\partial X_j/\partial \bar{P} = -\bar{P}\partial q/\partial c_j$, and $\partial X_j/\partial c_k = \partial X_k/\partial c_j$, and $\sum_{j=1}^{M} c_k(\partial X_j/\partial c_j) = \sum_{j=1}^{M} c_k\partial X_k/\partial c_j$. Thus, corresponding to (A.3) is

$$\begin{aligned}\text{(A.9)}\qquad \bar{P}\partial X_j/\partial \bar{P} + \sum_{j=1}^{M} c_j\,(\partial X_j/\partial c_j) &= -\bar{P}\partial q/\partial c_k + \sum_{j=1}^{M} c_j(\partial X_j/\partial c_k)\\ &= -\bar{P}\partial q/\partial c_k + \sum_{j} (\bar{P}F_j + Z_j)(\partial X_j/\partial c_k)\\ &= -\bar{P}\partial q/\partial c_k + \bar{P}\partial q/\partial c_k + \sum_{j} Z_j\partial X_j/\partial c_k\\ &= \sum_{j} Z_j\partial X_j/\partial c_k \neq \qquad \text{a constant or zero.}\end{aligned}$$

Reasoning analogous to that concerning supply functions indicates that in many circumstances inputs decrease when prices rise proportionately under risk-averse behavior. If this is an unwanted implication, then one should measure π in real income.

Appendix 2

Derivation of Equations (18′)–(20′)

First order conditions imply from (21) that

$$E[\alpha\pi^{\alpha-1}(PF_j - c_j)] = 0 \quad j = 1 \ldots M$$

or, utilizing standard results regarding expectations of products,

$$F_j\bar{P} - c_j = \frac{-E(\epsilon\pi^{\alpha-1})}{E(\pi^{\alpha-1})}F_j,$$

and by adding and subtracting $F_j\epsilon$ to both sides

$$\frac{\pi_j}{F_j} = \epsilon - \sigma \equiv \bar{K} \quad j = 1 \ldots M,$$

where $\sigma = E(\epsilon\pi^{\alpha-1})/E(\pi^{\alpha-1})$. Hence, the ratio of marginal profits to marginal product is constant and independent of j (Batra). Finally, as shown elsewhere (Sandmo), $E[U''(\pi)\pi_j] > 0$ under decreasing absolute risk aversion. Thus, also $E[U''(\pi)(\pi_j/F_j)] > 0$ assuming $F_j > 0$. Since $U'(\pi) = \alpha\pi^{\alpha-1}$ and $U''(\pi) = \alpha(\alpha - 1)\pi^{\alpha-2} < 0$ and noting e.g., $\partial q/\partial \bar{P} = \sum_{j=1}^{M} F_j(\partial X^*_j/\partial \bar{P})$, (18)–(20) become respectively,

$$[q^*K + \alpha E(\pi^{\alpha-1})](\partial q^*/\partial \bar{P}) \geq 0, \tag{18'}$$

$$-X^*_jK(\partial q^*/\partial c_j) - \alpha E(\pi^{\alpha-1})(\partial X^*_j/\partial c_j) \geq 0, \text{ and} \tag{19'}$$

$$\begin{aligned} X^*_kK(\partial q^*/\partial c_j) &+ \alpha E(\pi^{\alpha-1})(\partial X^*_k/\partial c_j) \\ &= X^*_jK(\partial q^*/\partial c_k) + \alpha E(\pi^{\alpha-1})(\partial X^*_j/\partial c_k), \end{aligned} \tag{20'}$$

where $K = E[U''(\pi)\bar{K}] = E[\alpha(\alpha - 1)\pi^{\alpha-2}(\epsilon - \sigma)] > 0$ under decreasing absolute risk aversion.

Decomposition Analysis of Derived Demand for Factor Inputs: The Case of Rice Production in Japan

Toshiyuki Kako

The process of the growth of rice production in Japan is analyzed by decomposition analysis of factor input demand. The variation in factor input demand is broken down into three components: output level, factor substitution along an isoquant, and technical change. The analysis is carried out using the estimates of Allen partial elasticities of substitution calculated from the fitted transcendental logarithmic cost function. The decline in labor input level is found to be due mainly to technical change, and the labor-saving effect of the factor substitution along an isoquant is relatively small.

Key words: decomposition analysis, Japan, partial elasticities of substitution, technical change.

The Japanese economy underwent rapid growth in the mid-1950s, and an annual rate of economic growth of more than 10% was maintained over the period 1955–70. The heavy industrialization of the Japanese economy increased both the labor absorption power of the industrial sector and the demand for land. This increased demand for labor was fulfilled by a transfer of a substantial part of the labor force from the agricultural sector. The number of workers engaged in agriculture decreased from 15.4 million in 1953 to 10.3 million in 1970, a drop of approximately 34%. Arable land also decreased from 6.0 million hectares to 4.9 million hectares during the same period.

Despite this drastic decrease in the labor force and in arable land, Japanese agriculture has achieved a high growth rate by international standards, partly based on the use of such industrial products as mini-tractors, fertilizers, and agricultural chemicals. These technical inputs have been supplied at decreased prices relative to primary inputs. Corresponding substitution of machinery and fertilizer for labor and land have been observed. Without the substitution of technical for primary inputs, the growth of Japanese agriculture might have been quite different because of the constraints imposed by resource scarcities. In this sense it is important to analyze factor substitution in the study of the process of Japanese agricultural growth.

In the early 1970s, methods were developed to estimate the elasticities of substitution for multifactor production by Christensen, Jorgenson, and Lau, and by Diewert. By these methods, the elasticities of substitution between pairs of factor inputs can be estimated with far fewer restrictions than by conventional methods.

In this study the process of Japanese agricultural growth will be analyzed from the viewpoint of factor demand. More specifically, the variation in factor input demand is decomposed into three components: output levels, factor substitution along an isoquant, and technical change. The decomposition analysis of factor inputs will be carried out using estimates of Allen partial elasticities of substitution (AES) and other parameters estimates obtained from the fitted transcendental logarithmic cost function. This framework will be used to investigate the mechanism of variation in factor input levels in rice production at the farm level for the period 1953–70. Rice was chosen because of the advantage in using a single crop rather than the entire agricultural sector in estimating the elasticities of substitution, and because it is the most important ag-

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ricultural crop in Japan. This decomposition analysis provides the following useful information for policy makers: the extent to which changes in factor prices affected the derived demand for inputs and the contribution of technical change to the saving of scarce resources.

Analytical Method

A twice differentiable production function relating the flow of rice (Y) to the services of five inputs, land (X_T), labor (X_L), machinery (X_M), fertilizer (X_F), and all other inputs (X_O), is assumed for rice production at the farm level. It is also assumed that rice production is characterized by constant returns to scale. Corresponding to such a function, there exists a cost function which reflects the production technology. In this study it has been assumed that rice production technology can be well represented by the translog cost function of the form

$$(1)\quad \ln C = U + V'_0 \begin{bmatrix} \ln & W \\ \ln & t \end{bmatrix} + \tfrac{1}{2} \begin{bmatrix} \ln & W \\ \ln & t \end{bmatrix}' \Gamma_0 \begin{bmatrix} \ln & W \\ \ln & t \end{bmatrix},$$

where

$$W = \begin{bmatrix} W_T \\ W_L \\ W_M \\ W_F \\ W_O \end{bmatrix}, t = \begin{bmatrix} t_1 \\ t_2 \\ t_3 \end{bmatrix}, V_0 = \begin{bmatrix} V_T \\ V_L \\ V_M \\ V_F \\ V_0 \\ V_{t_1} \\ V_{t_2} \\ V_{t_3} \end{bmatrix},$$

$$\Gamma_0 = \begin{bmatrix} \gamma_{TT} & \gamma_{TL} & \gamma_{TM} & \gamma_{TF} & \gamma_{TO} & \gamma_{Tt_1} & \gamma_{Tt_2} & \gamma_{Tt_3} \\ \gamma_{LT} & & & & & & & \cdot \\ \gamma_{MT} & & & & & & & \cdot \\ \gamma_{FT} & & & & & & & \cdot \\ \gamma_{OT} & & & & & & & \cdot \\ \gamma_{t_1T} & & & & & & & \cdot \\ \gamma_{t_2T} & & & & & & & \cdot \\ \gamma_{t_3T} & \cdot & \cdot & \cdot & \cdots & \cdot & \cdot & \gamma_{t_3t_3} \end{bmatrix},$$

and C is the minimum production cost, t is time, W_T is land rent, W_L is wage rate, W_M is hourly cost of machinery, W_F is fertilizer price, and W_O is other inputs price. Rice production technology 1953–70 can be classified into the following three subperiods, 1953–58, 1959–64, and 1965–70. Different indicator variables have been assigned to represent biased technical change, which is assumed to occur at a constant rate in each subperiod: $t_1 =$ 1 in 1953, through 18 in 1970; $t_2 = 2$ in 1959, through 7 in 1964, and all other years are unity; and $t_3 = 2$ in 1965, through 7 in 1970, and all other years are unity. The first subperiod was represented by biological and chemical technology. The second subperiod was characterized by a spurt in the use of hand tractors and by the rapid introduction of seed sprayers. In the third subperiod such large-scale mechanization as riding tractors was evident. In contrast, small-scale mechanization for the whole process of rice production, especially the development of rice transplanting machines and harvesting machines, was almost complete.

Using the Shephard duality theorem, it can be shown that the first derivatives of the translog cost function with respect to the log of the factor prices are equal to the cost shares (see Berndt and Wood):

$$(2)\quad \frac{\partial \ln C}{\partial \ln W_i} = \frac{\partial C}{\partial W_i} \cdot \frac{W_i}{C} = \frac{W_i X_i}{C} = M_i,$$

where M_i is the cost share of factor i. Using these derivatives from the translog cost function, the cost shares can be expressed as

$$(3)\qquad M = V + \Gamma \begin{bmatrix} \ln & W \\ \ln & t \end{bmatrix},$$

where

$$M = \begin{bmatrix} M_T \\ M_L \\ M_M \\ M_F \\ M_O \end{bmatrix}, V = \begin{bmatrix} V_T \\ V_L \\ V_M \\ V_F \\ V_O \end{bmatrix}, \Gamma = \begin{bmatrix} \gamma_{TT} & \gamma_{TL} & \gamma_{TM} & \gamma_{TF} & \gamma_{TO} & \gamma_{Tt_1} & \gamma_{Tt_2} & \gamma_{Tt_3} \\ \gamma_{LT} & & & & & & & \cdot \\ \gamma_{MT} & & & & & & & \cdot \\ \gamma_{FT} & & & & & & & \cdot \\ \gamma_{OT} & \gamma_{OL} & \gamma_{OM} & \gamma_{OF} & \gamma_{OO} & \gamma_{Ot_1} & \gamma_{Ot_2} & \gamma_{Ot_3} \end{bmatrix}.$$

It is assumed that the translog cost function is twice differentiable, so that the Hessian of this function is symmetric. This implies ten parametric constraints, $r_{ij} = r_{ji}$; $i, j = T, L, M, F, O$. Also, because it is a cost function, it must satisfy the economic constraints of linear homogeneity, i.e., the total cost doubles when all factor prices double. This implies that $\sum_i V_i = 1, \sum_i r_{ij} = 0, \sum_j r_{ij} = 0$; and $i \neq j, i, j = T, L, M, F, O$. Under the condition that the sum of the five cost shares is unity, the symmetry constraints and homogeneity constraints imply exactly the same constraints on the parameters. Hereafter, these constraints will be called symmetry-homogeneity restrictions.

Specification of the Estimation Equation and Data

The cost shares add up to unity, so the associated equations are lineally interdependent. Hence, the cost-share equation for land is eliminated from the system of estimation equations. It is assumed that the translog form is an exact representation of rice production technology. Additive error terms are included in the system of cost share equations. This error term may, for example, represent errors in cost minimization behavior. The statistical model is

$$(4)\quad \begin{bmatrix} M_L \\ M_M \\ M_F \\ M_O \end{bmatrix} = \begin{bmatrix} V_L \\ V_M \\ V_F \\ V_O \end{bmatrix} + \begin{bmatrix} \gamma_{LT} & \gamma_{LL} & \gamma_{LM} & \gamma_{LF} & \gamma_{LO} & \gamma_{Lt_1} & \gamma_{Lt_2} & \gamma_{Lt_3} \\ \gamma_{MT} & \gamma_{ML} & \gamma_{MM} & \gamma_{MF} & \gamma_{MO} & \gamma_{Mt_1} & \gamma_{Mt_2} & \gamma_{Mt_3} \\ \gamma_{FT} & \gamma_{FL} & \gamma_{FM} & \gamma_{FF} & \gamma_{FO} & \gamma_{Ft_1} & \gamma_{Ft_2} & \gamma_{Ft_3} \\ \gamma_{OT} & \gamma_{OL} & \gamma_{OM} & \gamma_{OF} & \gamma_{OO} & \gamma_{Ot_1} & \gamma_{Ot_2} & \gamma_{Ot_3} \end{bmatrix} \begin{bmatrix} \ln & W_T \\ \ln & W_L \\ \ln & W_M \\ \ln & W_F \\ \ln & W_O \\ \ln & t_1 \\ \ln & t_2 \\ \ln & t_3 \end{bmatrix} + \begin{bmatrix} \epsilon_L \\ \epsilon_M \\ \epsilon_F \\ \epsilon_O \end{bmatrix} .$$

It is assumed that the error vector $\epsilon = [\epsilon_L, \epsilon_M, \epsilon_F, \epsilon_O]'$ is independently and identically normally distributed with mean vector zero and nonsingular variance-covariance matrix Ω. The algorithm of the full information quasi-maximum likelihood estimator (*FIQML*), developed by L. Wegge in 1969, has been used to estimate the systems of cost-share equations (4). The *FIQML* has the advantage of being independent of the equation omitted from the system of equations (3). The estimators are not efficient because the time series and cross-section data are combined and the problem of error interdependence over time is neglected, but the estimators are still unbiased.

Data

The data required for *FIQML* estimation of the translog cost function are the prices and cost shares of the five inputs. The data are calculated from the "Annual Survey of Rice Production Cost," published by the Ministry of Agriculture and Forestry of the Japanese Government. In each year one rice producer has been chosen from each of the three land scales of rice production 0.5–1.0 hectares, 1.0–1.5 hectares, and 1.5–2.0 hectares, from the Kinki agricultural district for the period 1953–70. Over the eighteen years, fifty-four sample observations are available. For analysis, it is assumed that this agricultural district constitutes a homogeneous production area. A homogeneous production area is defined as a spacial unit, all parts of which have similar natural resource endowments—a similar unit price vector for all factors of production.

It is assumed that rice is produced with the twelve input categories $Y = F(X) = F(X_1, X_2, X_3, \ldots, X_{12})$. The twelve inputs are combined into five more highly aggregated inputs, land (X_T), labor (X_L), machinery (X_M), fertilizer (X_F), and other inputs (X_O), defined as follows: land is $X_T = f_T(X_1) = X_1$, where X_1 is land; labor is $X_L = f_L(X_2, X_3) = X_2 + wX_3$, where w is the weight representing wage ratio of female workers (X_3) and male workers (X_2) over time; and machinery is $X_M = f_M(X_4, X_5) = X_4 + vX_5$, where v is the ratio of the hourly cost for work animals (X_5) and power machinery (X_4) in each period; fertilizer is $X_F = f_F(X_6, X_7)$, where X_6 is fertilizer and X_7 is insecticides and herbicides; and other inputs are $X_O = f_O(X_8, \ldots, X_{12})$, where X_8 is seed and plants, X_9 miscellaneous inputs, X_{10} irrigation, X_{11} building and structures, and X_{12} tools and implements. X_F and X_O are calculated by the formula for the discrete divisia quantity index. Prices for labor, machinery, fertilizer, and other inputs are calculated by dividing the expenditures for each category by quantities. The expenditure for renting 0.1 hectare of paddy field is used as the cost of land in rice production. Data on land taxes were not available and are not included in the cost of land, which is thus undervalued.

Results

The four cost-share equations (4) have been estimated simultaneously with symmetry-homogeneity restrictions imposed. The symmetry-homogeneity restrictions reduce the number of free parameters from thirty-six to twenty-six. The estimation results are reported in table 1. A cost function is well behaved if it is an increasing function of input prices (monotonicity condition) and if it is concave in input prices. Since the translog cost function does not satisfy these conditions globally, the fitted cost function is checked for monotonicity and concavity at each observation. The monotonicity condition is satisfied if the fitted cost shares are positive, because $\frac{\partial \ln C}{\partial \ln W_i} = M_i$. Cost shares have been calculated based on the *FIQML* parameter estimates. All cost shares are found to be positive. The concavity of the cost function is satisfied if the Hessian matrix, based on the *FIQML* parameter estimates, is negative semidefinite. This condition is also satisfied at each observation. Thus the estimated *FIQML* translog cost function is well behaved within the region of the sample observation.

Table 1. *FIQML* Estimates of the Cost Share Equations of the Translog Cost Function

V_L	.4762	γ_{FO}	.0404
	(11.258)		(1.642)
V_M	.0855	γ_{OT}	−.0083
	(3.239)		(−1.880)
V_F	.5692	γ_{OO}	−.0729
	(9.270)		(−5.220)
V_O	−.1016	γ_{t1L}	−.0221
	(−1.141)		(−3.623)
γ_{LT}	−.0213	γ_{t2L}	−.0047
	(−4.176)		(−1.068)
γ_{LL}	.0513	γ_{t3L}	−.0343
	(3.857)		(−5.484)
γ_{LM}	−.0034	γ_{t1M}	.0043
	(−.500)		(1.024)
γ_{LF}	−.0631	γ_{t2M}	.0006
	(−6.010)		(.128)
γ_{LO}	.0364	γ_{t3M}	.0173
	(5.433)		(4.943)
γ_{MT}	−.0228	γ_{t1F}	.0152
	(−6.514)		(4.903)
γ_{MM}	.0364	γ_{t2F}	−.0008
	(5.871)		(−.421)
γ_{MF}	−.0145	γ_{t3F}	.0032
	(−2.500)		(.457)
γ_{MO}	.0043	γ_{t1O}	.0082
	(.977)		(1.608)
γ_{FT}	−.0114	γ_{t2O}	.0022
	(−1.966)		(.361)
γ_{FF}	.0485	γ_{t3O}	.0080
	(2.266)		(1.951)

Note: t values are in parentheses.

Allen Partial Elasticities of Substitution

In the translog cost function, *AES* can be expressed as the functions of cost shares and the coefficients of cost share equations (Binswanger 1973):

$$\sigma_{ij} = \frac{1}{M_i M_j} r_{ij} + 1 \quad \text{for all } i \neq j,$$

$$\sigma_{ii} = \frac{1}{M_i^2} (r_{ii} + M_i^2 = M_i) \quad \text{for all } i.$$

The *AES* between factors i and j measures the normalized impact of a change in the price of the jth factor on the amount demanded of the ith factor when output is held fixed and quantities of all other factors are permitted to vary. *AES* and price elasticity for factor demand are related as follows (Mundlak):

$$(5) \quad E_{ij} = \left(\frac{\partial \ln X_i}{\partial \ln W_j}\right) Y,\ W_K = M_j \sigma_{ij}$$

$$\text{for all } i, j, \quad k \neq j.$$

where E_{ij} represents price elasticity for factor demand and measures the proportional change in the demand for factor i of a proportional change in the price of the jth factor when output and all other factor prices are fixed. Thus, *AES* is equal to E_{ij} multiplied by the inverse of the cost share. Since the cost share is always positive, E_{ij} and σ_{ij} take the same sign. Hence, positive *AES*s between inputs i and j indicate that they are substitutes. A negative *AES* implies that the factors i and j are complements.

The *AES* and the own-price elasticities of factor demand (E_{ii}) were calculated on the average factor price level in each year (tables 2 and 3). Labor's best substitute appeared to be other inputs. Machinery and land were also substitutes for labor. The substitutability of labor and machinery tends to be quite high. The value of σ_{LM} is about 0.93, similar to that of traditional two-input (capital-labor) studies. Fertilizer was a substitute for labor in the 1950s, but thereafter became a complement to labor. Fertilizer and other inputs were substitutes for machinery. Machinery, fertilizer, and other inputs were complements to land in the early period, but later became substitutes. A

Table 2. *FIQML* Estimated Allen Partial Elasticities of Substitution

	σ_{TL}	σ_{TM}	σ_{TF}	σ_{TO}	σ_{LM}
1953	.760	−.249	.608	.214	.933
1958	.771	.000	.645	.410	.933
1964	.798	.078	.535	.566	.934
1970	.816	.361	.507	.701	.934

	σ_{LF}	σ_{LO}	σ_{MF}	σ_{MO}	σ_{FO}
1953	.210	2.244	.117	1.715	5.211
1958	.111	2.159	.163	1.561	4.716
1964	−.248	1.915	−.221	1.460	5.357
1970	−.900	1.906	−.421	1.348	6.039

principal finding from table 2 is that technical possibilities of substitution exist for some pairs of inputs; σ_{LO}, σ_{MO}, and σ_{FO} are larger than one. Table 3 shows that the own-price elasticities of demand for land, labor, machinery, and fertilizer are inelastic: values range from −0.3 to −0.6. Binswanger (1974) has estimated own-price elasticities of factor demand for U.S. agriculture using the translog cost function. The average values for the period 1949–64 are −0.336 for land, −0.911 for labor, −1.089 for machinery, −0.945 for fertilizer, and −1.042 for other inputs.

The Theory of Decomposition Analysis

If rice producers attempt to minimize the cost of producing a prescribed level of output, the equilibrium quantity of the factor input i is a function of the level of output, factor prices, and technology, i.e.,

$$(6)\ X_i = H(Y, W_T, W_L, W_M, W_F, W_O, A),$$

where $i = T, L, M, F, O$, and where X_i is the equilibrium demand for factor i, Y is the output level, and A the technology index. Now, if the production function is characterized by constant returns to scale, equation (6) can be written

$$(7)\ X_i = Y \cdot K(W_T, W_L, W_M, W_F, W_O, A).$$

Table 3. *FIQML* Estimated Own-Price Elasticities of Factor Demand

	E_{TT}	E_{LL}	E_{MM}	E_{FF}	E_{OO}
1953	−.464	−.401	−.549	−.538	−2.178
1958	−.482	−.432	−.565	−.533	−1.989
1964	−.491	−.423	−.563	−.443	−1.774
1970	−.488	−.465	−.588	−.320	−1.647

Total differentiation of equation (7) yields

$$(8)\quad dX_i = \left(\frac{\partial X_i}{\partial Y}\right)_{W_j,A} \cdot dY + \sum_k \left(\frac{\partial X_i}{\partial W_K}\right)_{Y,W_j,A} \cdot dW_K + \left(\frac{\partial X_i}{\partial A}\right)_{Y,W_j} \cdot dA.$$

By algebraic manipulation, equation (8) can be written as

$$(9)\quad dlnX_i = \left(\frac{lnX_i}{lnY}\right)_{W_j,A} \cdot dlnY + \left(\frac{lnX_i}{lnW_K}\right)_{Y,W_j,A} \cdot dlnW_K + \left(\frac{lnX_i}{lnA}\right)_{Y,W_j} \cdot dlnA.$$

Constant returns to scale imply that the factor demand elasticity with respect to output is unity, $\left(\frac{\partial lnX_i}{\partial lnY}\right) = 1$, so equation (9) can be alternatively expressed as

$$(10)\quad dlnX_i = dlnY + \sum_K E_{iK} dlnW_K + \left(\frac{\partial\, dlnX_i}{\partial\, dlnA}\right)_{Y,W_j} \cdot dlnA.$$

Substituting equation (5) into (10) gives

$$(11)\quad dlnX_i = dlnY + \sum_K M_K \sigma_{iK} dlnW_k + \left(\frac{\partial lnX_i}{\partial lnA}\right)_{Y,W_j} \cdot dlnA.$$

The first term of the right hand side of equation (11) measures the effect of a variation in Y on the equilibrium quantity X_i when $w_j (j = T, L, M, F, O)$ and A are held constant. This is the "output effect" on factor demand. The second expression on the right-hand side, a summation, measures the cumulative effect of variations in factor prices on the equilibrium quantity X_i when Y and A, as well as the prices of each of the other factor inputs, w_j, are held constant. This is the "total substitution effect" of the variation in factor prices on the factor demand. The last term on the right-hand side of equation (11) measures the effect of technical change in the equilibrium quantity X_i when all factor prices and the output level are held constant—the "technical change effect."

Results of the Decomposition Analysis

Decomposition analysis has been applied to rice production as follows: (*a*) The change in the factor input level due to "output" and the "total substitution effect" is calculated using estimates of the parameters of the translog cost function. (*b*) The "technical change effect" is calculated as a residual obtained by subtracting the sum of the calculated change in the factor input level due to "output effect" and the "total substitution effect" from actual, observed change in the input level. The residual technical change effect calculated in this way includes both the technical change effect and the residual of the estimation (the difference between actual and predicted change in input level). The results of decomposition analysis are reported in table 4.

Land. There was little change in the actual land input level used for rice production over the eighteen-year period. It was found that the positive output effect was nullified by the negative total substitution effect and by the residual technical change effect.

Labor. Labor input level declined by an annual average of 2.6%, mainly due to the negative technical change effect. The total substitution effect was also negative. A relatively large (negative) own-substitution effect ($M_L \sigma_{LL} \Delta ln W_L$) due to the fast increase in the wage rate was also found to be responsible for the negative substitution effect.

Machinery. The machinery input level showed an annual growth rate of 3.9%. The output effect contributed about 68% of this rate; the total substitution effect averaged 44%. The technical change effect was on the average negative, but the value was small relative to the positive output and total substitution effects.

Fertilizer. The input level of fertilizer grew

Table 4. Decomposition Analysis of Variation in Five Factor Input Levels (Annual Rate of Growth)

	Observed Change $ln \frac{X_{jt}}{X_{jt-1}}$	Output Effect $ln \frac{Y_t}{Y_{t-1}}$	Total Substitution Effect $\sum_i M_i \sigma_{ji} ln \frac{W_{it}}{W_{it-1}}$	Residual Technical Change Effect
Land				
1953–58	.002	.050	−.064	.016
1958–64	−.003	.009	−.003	−.009
1964–70	.003	.025	.024	−.046
Average	.000	.027	−.012	−.015
	(100%)	(7533.3%)	(−3316.7%)	(−4116.7%)
Labor				
1953–58	−.006	.050	.015	−.071
1958–64	−.047	.009	−.031	−.025
1964–70	−.022	.025	−.024	−.023
Average	−.026	.027	−.015	−.038
	(100%)	(−102.7%)	(57.1%)	(145.9%)
Machinery				
1953–58	−.004	.050	−.010	−.044
1958–64	.039	.009	.038	−.009
1964–70	.075	.025	.019	.032
Average	.039	.027	.017	−.005
	(100%)	(68.4%)	(44.0%)	(−12.4%)
Fertilizer				
1953–58	.065	.050	.036	−.021
1958–64	.022	.009	.031	−.018
1964–70	.049	.025	.002	.022
Average	.044	.027	.022	−.005
	(100%)	(60.5%)	(50.1%)	(−10.6%)
Other inputs				
1953–58	.038	.050	.029	−.040
1958–64	.079	.009	.069	.001
1964–70	.075	.025	.027	.024
Average	.066	.027	.042	−.003
	(100%)	(40.5%)	(64.5%)	(−5.0%)

by an annual average of 4.4%. To this, output effect contributed 60.5%; total substitution effect, 50.1%. The effect of technical change on the input level was negative, but the magnitude of negative technical change effect was small relative to the positive output and total substitution effects.

Other inputs. Other inputs showed an average annual growth of 6.6%, brought about by the positive output and total substitution effects. The technical change effect was negative on the average.

In all five inputs, the technical change effect was negative, those of scarce resources, land and labor, being larger than the technical change effects of machinery, fertilizer, and other inputs. If the technical change were Hicks-neutral, then these effects on the proportional changes in input requirements would have to be identical. Biased technical change, which is the nature of scarce resource saving, may be the cause of these large negative technical change effects. To clarify this point, consider the change in the factor combination of labor and its typical substitute, machinery.

Figure 1 illustrates the analytical framework of biased technical change. I_t and E_t are the isoquant and the equilibrium point, respectively. The slope of the straight line OR_t gives the factor combination ratio of labor and machinery in the base period. Now, suppose technical change took place and the isoquant shifted from I_t to I_{t+1} and that there was a change in relative factor prices, then E_{t+1} stands for the equilibrium point and the slope of line OR_{t+1} is the factor combination ratio in the comparative period. The shift of the isoquant from I_t to I'_{t+1} describes neutral technical change in the Hicksian sense, and I_t to I_{t+1} describes labor-saving and machinery-using technical change. The change in the factor combination ratio from OR_t to OR^* is attributable exclusively to the change in the relative input price. This is the substitution effect. The movement from OR^* to OR_{t+1} is attributable exclusively to biased technical change. The slope of OR^* can be calculated as $\frac{X^*_{Mt+1}}{X^*_{Lt+1}}$, where $X^*_{Lt+1} = X_{Lt} + X_{Lt} \cdot \sum_i M_i \sigma_{Li} \Delta ln W_i$ and $X^*_{Mt+1} = X_{Mt} + X_{Mt} \cdot \sum_i M_i \sigma_{Mi} \Delta ln W_i$. The results of this calculation for the period 1953–69 are reported in table 5. About 70% of the change in the factor combination ratio was attributable to labor-saving technical change.

The same calculation was carried out for land and its typical substitute, fertilizer. About 26% of the change in the factor combination was attributable to land-saving technical change. The remaining 74% is attributable to change in the relative factor prices and in the Allen partial elasticities of substitution over time.

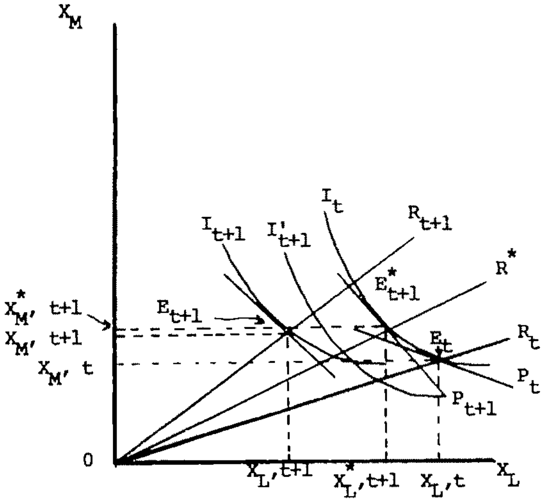

Figure 1. Changes in factor combination and biased technical change

Conclusion

First, the Allen partial elasticities of substitution were estimated, then the variation in factor input demand was broken down into three components. Technical change effects were negative for all of five inputs on the average over the eighteen-year period. The major part of the reduction in the labor input level is attributable to labor-saving technical change. The substitution of machinery for labor due to the change in machinery price was small. The

Table 5. Changes in Factor Combination Ratio and Biased Technical Change 1953–70

	Total Change in Factor Combination	Due to Substitution	Due to Biased Technical Change
$\frac{X_M}{X_L}$	.149 (100%)	.045 (30%)	.104 (70%)
$\frac{X_F}{X_T}$	.301 (100%)	.223 (74%)	.078 (26%)

decline in the price of fertilizer, the typical substitute for land, did not contribute much to the reduction of land input level. The total substitution effects of machinery, fertilizer, and other inputs supplied from the nonagricultural sector at relatively declining prices were positive. With respect to the total substitution effect of machinery, the increase in the wage rate played an important role in increasing the input level of machinery. However, the total substitution effects of scarce resources—land and labor—were negative, largely due to the negative own-substitution effect.

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Notes

Patron Valuation of a Farmer Cooperative under Alternative Finance Policies

James G. Beierlein and Lee F. Schrader

Farmer cooperatives have grown and prospered in recent years. This growth has resulted in larger individual cooperatives and, in some cases, increased market shares held by cooperatives. This expansion has attracted greater public interest in cooperatives, and critics have attacked both the unique tax treatment and antitrust exemptions accorded agricultural cooperatives (*Business Week*, p. 102). There has been growing pressure on various regulatory agencies and legislators to redefine the rules governing cooperatives. A number of the proposed changes would affect the capital structure of cooperatives.

The objective of this paper is to analyze the effect that changes in capital structure have on the financial value of a cooperative to its member patrons. While this analysis introduces no additions to the theory of cooperative finance, it does contribute to the understanding of the nature and importance of the unique relationships that exist between an owner-patron and his cooperative, as contrasted to the relationship found between a corporation and its owners. Three policy options are analyzed: (*a*) payment of a required return on all forms of member-contributed capital; (*b*) changes in the minimum cash proportion of the patronage refund; and, (*c*) limited length of revolving fund cycle.

Cooperative corporations are primarily distinguishable from other business firms because they operate on a cost-of-doing business basis. In effect, the cooperative does business with a prior commitment to return any revenues above costs and capital needs to its patrons. The amount of the return (patronage refund) is a function of patronage volume rather than the amount of capital invested. In addition, cooperatives are characterized by limited returns on capital and member control through one-man-one-vote. These characteristics substantially reduce the attractiveness of cooperative investment to nonpatrons and compel the organization to rely on member patrons for a major portion of investment capital.

Unlike the normal corporate organization, the financial returns generated by cooperative patronage represent a combination of earnings. They may be attributable to extending the patrons' farm business to another level of the commodity system as well as to the capital invested at that level. The flow of funds to the patron is quite clearly a function of his business volume with the cooperative, the extent of value added by the organization, and the capital structure of the cooperative. It is vital that the simultaneity of the owner-customer relationship be included in any analysis of patron benefits.

The authors contend that the analysis of policies affecting the capital structure of cooperatives must be in terms of the flow of funds to member patrons over the relevant patronage horizon. Further, the evaluation of the flow of funds must reflect the personal tax rates, opportunity costs, and financial status of patrons or patron groups affected.

Method of Analysis

A deterministic simulator of cooperative and patron cash flows constructed by Beierlein is used to evaluate the impact of changes in cooperative capital structure on the level of patron benefits. The simulator represents an independent cooperative that sells supplies to, or purchases products from, patrons at prices comparable to noncooperative businesses performing the same functions. The latter specification represents the prevalent policy of midwestern cooperatives and simplifies the analysis since the full financial return to patrons relative to noncooperative alternatives is represented by payments or allocations to patrons. The analysis includes only direct benefits to patrons and assumes all relationships hold exactly in each year. This simulator gives a first measure of the acceptability of cooperative investment by determining if the net present value (NPV) of the cash flows is positive for the given opportunity costs and tax rates.

The simulator measures the after tax present value of patron financial benefits from a given capi-

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tal structure for as many as ten patron groups that are characterized by different marginal personal tax rates, annual growth rates of cooperative patronage, and opportunity costs for a maximum patronage horizon of twenty years. The cash flows are calculated for each patron group using appropriate parameters (i.e., opportunity cost and marginal personal tax rate). The total value of benefits is determined by summing the benefits of each group. The calculations do not include an adjustment for inflation. Return on invested capital before taxes, interest, and dividends (ROIC) is assumed to be a constant proportion of total capital employed in the cooperative each period. Provision is made for a portion of business not conducted cooperatively and appropriate federal income tax treatment of net margins at both the cooperative and patron levels.

The organization can be capitalized using any combination of the following forms of member capital generated from internal cash flows: capital stock, revolving funds of qualified and nonqualified patronage refunds, unallocated retained savings, and member debt. Capital contribution from other than member-patrons is allowed but is limited to debt instruments. For valuation purposes all the stock is assumed to be redeemed at book value one year beyond the end of the patronage horizon. This does not imply liquidation because some patrons are leaving the cooperative each year.

The amount of investment required each period is determined by the weighted average growth rate of patron business together with the amount of replacement capital needed (i.e., maturing debt, and revolving funds). Each period's cash flows available for investment are compared with the amount of new investment required. If sufficient funds are available, the investments are made, remaining funds are distributed as cash patronage refunds, and the after tax present value of the payments or allocations to patrons is computed for each patron group. If funds are not sufficient, the plan is deemed infeasible and the process halts. Computed present values represent the sum of individual values resulting from patronage during the full simulation period.

Tubbs was the first to investigate the impact of patron cooperative contributions on farm operations using discounted cash flow. His analysis focused on the impact of patron contributions on the farm business without measuring the consequences of the cooperative business. Fenwick evaluated the capital structure of cooperatives at the patron level; however, his analysis focused on the recovery value of patron capital without regard to the value of future savings to the patron. Wilson developed a simulator similar to the Beierlein model which evaluated the full cash flow to two member groups (old and new) for both "exempt" and "nonexempt" tax treatment for a ten-year period. The Wilson model does not consider the use of nonqualified patronage refunds and does not include provision for individual patron growth but allows for detailed specification of performance relationships in up to ten operating divisions. Dahl used a recursive linear programming model to minimize the cost of capital to the cooperative without measuring the effect on the level of patron benefits.

The Base Case and Simulator Assumptions

The base case used in the analysis represents an average of three selected Indiana farmer cooperatives believed to represent a typical midwestern grain marketing and farm supply cooperative. The cooperative does not qualify for "tax exempt" status as defined under Section 521 of the Internal Revenue Code but does operate on a cooperative basis within the scope of Sub-chapter T of the Code, which allows the exclusion of qualified patronage refunds from the taxable income of the cooperative. The qualified patronage refund (cash and other returns allocated according to patronage) is taxed only at the patron level. Nonqualified returns are taxed at the cooperative level (see Schrader and Goldberg, chap. 1).

The base case situation has the following capital structure: 20% stock paying no dividends; 15% revolving fund from qualified patronage refunds; zero percent from revolving funds from nonqualified patronage refunds; 15% unallocated retained savings; 15% member debt; and 35% nonmember debt. The base case also has return on invested capital (ROIC) before taxes, interest, and dividends of 15%; interest rate on member debt of 5%; interest rate on nonmember debt of 7%; and 80% of business done with members on a patronage basis.

In addition, the following assumptions are supplied: (*a*) 5% of the stock is retired each year to reflect payments made to members who have died or retired from active membership; (*b*) 10% of the member debt is retired each period as part of the ten-year loan agreements; (*c*) when a revolving fund of qualified patronage refunds is used, equal installments of the initial amount of the fund are retired during the initial cycle of the fund (i.e., with a ten-year revolving fund with an initial value of $10,000, $1,000 would be retired in each of the first ten years); (*d*) corporate tax rates used are 22% for all taxable income plus a 26% surtax on all taxable income above $25,000 with a 10% investment credit where applicable; (*e*) the patron group characteristics represent the authors' assumptions based on other research (U.S. Department of Agriculture).[1] The two assumed patron groups are defined as follows:

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[1] The opportunity cost values are represented by the after tax return to equity for farms in the Corn Belt using the assumed marginal personal tax rates for each group.

	Patron Group 1	Patron Group 2
	%	%
Marginal personal tax rate	20	25
After tax opportunity cost	4	6
Percentage of total patron sales by patron group	50	50
Nominal annual rate of growth in business done with the cooperative	1	1

Capital Structure, Patron Benefits, and Cooperative Growth Potential

The capital structure of a farmer cooperative can have a significant impact on the organization's growth potential and on the level of patron benefits. The relationship is complex and can be affected by both patron and cooperative business characteristics. Despite these limitations, it is possible to determine some general relationships. To illustrate these relationships, the level of patron benefits and the maximum growth rate are determined for the base case and the following six capital configurations: (*a*) all revolving funds from nonqualified patronage refunds; (*b*) all member debt (5%); (*c*) all revolving funds from qualified patronage refunds; (*d*) all nondividend-paying stock; (*e*) all nonmember debt (7%); and (*f*) 50% nondividend-paying stock and 50% nonmember debt. While some of these capital configurations are impractical, their use allows a clear examination of their impact on patron benefits and the cooperative's growth potential. In each case the annual patronage growth rate is increased to a maximum of 15% or until cash flows are insufficient. The results of this procedure are presented in table 1.

The exclusive use of nonqualified patronage refunds and member debt proved infeasible in this situation at all growth rates. Their inability to support the capital structure arises from the requirement of large cash outflows each year and a low rate of return on invested capital. The revolving fund from qualified patronage refunds proved to be an acceptable means of financing the organization but proved infeasible at growth rates of more than 1% per year. Despite a limited growth potential, the use of all nondividend-bearing stock produced the highest level of patron benefits for growth rates of up to 6% per year. Under the assumptions of the simulator, nonmember debt does not come from internal cash sources and is, therefore, not constrained. The use of this form of capital has no upper bound but it generates the highest returns to patrons only at growth rates above 11%. A capital structure utilizing a more realistic proportion of 50% nonmember debt and 50% nondividend-bearing stock provided a reasonable rate of return below 6% and the highest level of benefits at rates between 6% and 11%. In this situation, the maximum growth rate is a function of the capital structure of the organization.

Table 1. The After Tax Present Value of Patron Benefits under Various Hypothetical Capitalizations over a Twenty-Year Period

	Capitalization Schemes Using				
Annual Growth Rate in Cooperative Patronage	Base Case	100% Non-Dividend-Paying Stock	100% Qualified Revolving Fund	100% Nonmember Debt	50%-Stock 50%-Nonmember Debt
	$ thousands				
%					
0	1,092	1,167	966	781	1,003
1	1,140	1,205	1,011	848	1,061
2	1,189	1,248	—	922	1,124
3	1,243	1,297	—	1,005	1,192
4	1,300	1,350	—	1,096	1,268
5	1,363	1,410	—	1,198	1,353
6	1,425	1,477	—	1,311	1,450
7	1,489	—	—	1,439	1,557
8	1,547	—	—	1,582	1,679
9	1,598	—	—	1,743	1,815
10	1,645	—	—	1,925	1,969
11	—	—	—	2,130	2,142
12	—	—	—	2,361	2,337
15	—	—	—	3,250	3,081

Note: Cash flows discounted half at 4% and half at 6%; ROIC = 15%.

A heavy reliance on nonmember debt helps to increase the organization's growth potential but imposes a number of serious limitations. First, the ability to survive adversity is reduced. Interest payments must be met where similar payments to owner patrons could be deferred in bad years. Second, any organization that owns 50% of the cooperative's capital would desire, if not require, a strong voice in the management of the cooperative.

In each case, the capital structure does affect the growth potential and level of patron benefits. The benefit stream is evaluated as if the cooperative had been financed according to the specified structure from period one. No attempt has been made to evaluate the benefits with a transition period from the base case to any alternative. Having shown that capital structure does affect the level of patron benefits, it is possible to proceed to the evaluation of the three policy options mentioned earlier. Each option will be analyzed with respect to the effect it would have on the member-patrons of a typical midwestern cooperative (the base case).

Patron Benefits under Alternative Financing Policies

The first policy option examined is the payment of a required return on all member-owned capital. Proponents believe that requiring such payments would increase the level of patron benefits. Three variations on the base case cooperative's capital structure are analyzed: (*a*) changing the dividend on stock from 0% to 5%; (*b*) shifting all qualified revolving funds to member debt with a 5% interest rate; and (*c*) both (*a*) and (*b*). The value of patron benefits under the three options is given in table 2.

The introduction of a 5% dividend on stock raises the value of the capital invested, but this increase is more than offset by a reduction in the value of the stream of cash refunds. The result is a reduction of total patron benefits of 5.6% from the zero dividend case. Hence, the introduction of a dividend payment reduces the overall level of patron benefits in this situation. Member-owned debt in this instance results in cash flow equivalent to the payment of a return on qualified revolving funds. The payment of a return on these funds raises the level of the return to capital invested, but again this increase is more than offset by a reduction in the value of the stream of cash refunds. The result is reduction of total benefits of 9.3% from the base case. The application of both a 5% dividend on stock and a required payment on qualified revolving funds gave a reduction of total benefits of 14.4% from the base case. In each instance the payment of a return on member contributed capital resulted in a decline in the level of patron benefits from the base case.

The second option under examination is the requirement for higher cash payments from patronage refunds. Current law requires that at least 20% of the patronage refund be in the form of cash if the refund is to be exempt from taxation at the cooperative level. The argument has been made that increasing this percentage will raise the level of patron benefits. To measure the impact of changes in this percentage, the minimum cash refund percentage is set at various levels between 0% and 50% of the patronage refund. The patronage growth rate is then increased until cash flows are just sufficient to meet the need in any year over the 20-year planning horizon. Table 3 shows that an inverse relationship exists between the required level of cash refunds and the maximum growth rate attainable. This result is what one would expect as larger amounts of cash are to be returned to the patrons and less money is available for investment. In the situation analyzed, the total value of patron benefits also decreases as the level of cash payments is increased. The rate of earnings at the cooperative level exceeds opportunity costs at the farm level and the higher growth path is preferred. This result depends on growth in earnings which accrues only to patrons whose business with the cooperative increases at the same pace.

The third option analyzed is a reduction in the length of the revolving fund cycle. The belief is that

Table 2. The After Tax Present Value of Patron Benefits with Varying Levels of Payment for Member-Contributed Capital over a Twenty-Year Period

	Present Values		
Capitalization	Total Patron Benefits	Capital Invested[a]	Cash Refund
	$ thousands		
Base case	1,140	136	1,004
A. Five percent dividend on stock	1,076	180	895
B. Transfer of qualified revolving fund to member debt	1,033	137	896
Both A and B	975	176	799

Note: ROIC = 15%; cash flows discounted half at 4% and half at 6% cooperative patronage growth rate = 1%.

[a] The present value of capital is the sum of the annual interest or dividend payments plus the recovery value of the investment.

Table 3. The After Tax Present Value of Patron Benefits and Maximum Cooperative Patronage Growth Rates under Varying Levels of Required Cash Refunds Using the Base Case Capitalization over a Twenty-Year Period

Level of Required Cash Refund	Maximum Annual Patronage Growth Rate Attainable	Present Values: The Cash Refunds	Present Values: Capital Invested[a]	Present Values: Total Patron Benefits
%	%	$ thousands	$ thousands	$ thousands
0	13	216	1,537	1,753
10	12	420	1,302	1,722
20	10	719	926	1,645
30	9	821	777	1,598
40	7	951	538	1,489
50	6	981	444	1,425

Note: Cash flows discounted half at 4% and half at 6%; ROIC = 15%.

[a] The present value of capital is the sum of annual dividend or interest payments and the recovery value of the investment.

reducing the delay in receiving this money will raise the level of patron benefits. To show the effect of such changes, the revolving fund period is reduced from ten to five and seven years with three capital configurations: (*a*) 15% revolving fund, 20% nondividend-bearing stock, 15% unallocated retained savings, 15% member debt, and 35% nonmember debt; (*b*) 25% revolving fund and 75% nondividend-bearing stock; and (*c*) 50% revolving fund and 50% nondividend-bearing stock. Under each of these alternatives the revolving fund began to operate immediately with the beginning amount of the fund being revolved out on time and in equal installments.

Data presented in table 4 indicate that shortening the payback period has only a negligible effect (slightly more than 2%) on the after tax present value of patron benefits over the twenty years. In fact, where the revolving fund consisted of 50% of the capitalization, shortening the revolving fund resulted in an infeasible set of cash flows. Shortening the length of the revolving fund cycle forces the organization into a situation in which it must retain more of each year's savings to replace the retiring

Table 4. The After Tax Present Value of Patron Benefits with Changing Revolving Fund Lengths with Capital Structures Using Varying Percentages of Qualified Revolving Funds over a Twenty-Year Period

Length of Qualified Revolving Funds in Years	Amount of Qualified Revolving Fund Retired Each Year	Present Values: Total Patron Benefits	Present Values: After Tax Present Value of the Cash Refund	Present Values: Capital Invested[a]
	$ thousands	$ thousands	$ thousands	$ thousands
		15% Revolving Fund		
5	30	1,164	990	174
7	22	1,153	996	157
10	15	1,140	1,004	136
		25% Revolving Fund		
5	50	1,274	632	642
7	36	1,270	726	544
10	25	1,261	817	443
		50% Revolving Fund		
5	100	infeasible	—	—
7	71	infeasible	—	—
10	50	1,218	668	550

Note: Cash flows discounted half at 4% and half at 6%; ROIC = 15%.

[a] The present value of capital is equal to sum of annual dividend or interest payments and the recovery value of the investment.

capital. This results in less cash being available for distribution each year with no significant increase in the amount of capital invested. The increase in the value of the revolving fund is all but offset by the decline in the value of the cash refund.

Concluding Remarks

The analyses presented illustrate the complexity of the set of relationships among the capital structure of a cooperative, the value of benefits to its patrons, and its rate of growth. Analyses of the impact of changes in capital structure which evaluate only cooperative earnings (net savings) or only recovery of past investment may lead to invalid conclusions. Generalizations about the desirability of particular capital plans are difficult because of the interaction with patron characteristics.

It has been demonstrated that two policies which are commonly considered favorable to patrons (required returns on all patron equity and increased minimum cash patronage refund) result in lower patron benefits under the conditions analyzed. Measures to increase immediate payout to patrons also limit increases in returns in later periods. Although not treated specifically in the analyses reported above, the differential impact of particular policies on patrons with different growth rates, opportunity costs, or patronage horizons must also be considered.

The simulator proved to be a useful means for the comparison of alternative financial structures. Its deterministic nature and naive treatment of capital expenditure limit its use as a general planning aid. The authors conclude that this or a similar model represents a minimum instrument for planning the capital structure of an individual cooperative or for evaluating the impact of changes in policy toward financing farmer cooperatives.

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Efficiencies in Large-Scale Dairying: Incentives for Future Structural Change

Scott C. Matulich

The United States dairy industry is undergoing a profound transformation towards intensive large-scale production units. During the ten-year period 1964–74, the number of farms with cows declined 71%, while the number of cows declined only 29% (U.S. Department of Commerce, 1964, 1974). According to the U.S. Department of Agriculture, total milk production declined 9%, from 127.0 billion pounds to 115.6 billion pounds. The structural impact of this consolidation into fewer but larger herds is considerable. Both farm and cow numbers have declined for herd sizes less than fifty cows and increased for herd sizes fifty cows or larger. The smallest herd size range, 1–29 cows, experienced the greatest loss—an 80% decline in farms and 71% decline in cows. Conversely, the largest herd-size category evidenced the greatest increase. Dairies with 200 or more cows increased 65%, while cow numbers increased 82%. By 1974, herds greater than or equal to 200 cows constituted only 1% of the farms but 14% of the cows.

The trend towards large-scale dairies is unmistakable, but the concept of "large-scale" appears to be regionally oriented. In 1974, the preponderance of dairies in the 200-plus category were located in the West and South, 51% and 31%, respectively. Though the distribution of large-scale dairies is geographically skewed (principally to California, Florida, Arizona, and Texas), all but two states have dairies in this size range. Moreover, all but nine states have herds of 500 or more cows (U.S. Department of Commerce, 1974).

Numerous technological advances have provided economic incentives for consolidation and herd expansion. In particular, major advances have been achieved in milking systems, feeding, and general herd management. The objective of this paper is to examine the extent of such economic incentives and gain insights into potential future structural change in the U.S. dairy industry. Analysis of the long-run average cost (LRAC) curve for dairies in the Chino Valley of California provides the basis of this investigation. Dairies in the Chino Valley are perhaps the most extreme example of large specialized dairies. Average size herds of 600 cows are confined to 10 to 60 acres; several herds are in excess of 2,000 cows. In this study, large-scale herds ranging from 375 to 3,600 cows are analyzed. Availability of scale economies reveals the limit to which incentives exist for further structural change.

Analytical Framework

Empirical analysis of efficient large-scale dairy production involves estimation of both short- and long-run costs. The economic-engineering approach, as formulated by French, Sammet, and Bressler and outlined by French, formed the methodological basis for this analysis. The dairy was disaggregated into the various stages of production. In particular, three technical stages coordinated by management were evaluated: milking, housing, and feeding. Detailed input-output relationships were specified for each stage and combined into model dairies of various sizes. Required quantities of fixed and variable inputs were combined with their market prices to synthesize both short-run and long-run cost functions. Such an approach facilitated analyzing both typical and new, but not widely adopted, dairy production technologies.

A fourth stage, waste management, was analyzed in the original study, but does not lend itself to generalizations regarding dairy production efficiency in spite of potential efficiency implications. While often believed to be a source of diseconomies, especially in light of increasingly stringent environmental quality regulations, waste management may be a source of economies (Matulich, Carman, Carter). Waste management is a complex problem unique to the specific production setting and must be analyzed accordingly. Thus, it is omitted from the present discussion.

Dairy Production Stages

Alternative milking parlors and varying degrees of mechanization are of primary importance in determining the annual cost of the milking stage. Although there are six basic types of milking barns or parlors, only herringbone, side-opening, and polygon parlors were selected as relevant to large-scale dairying. A fourth parlor configuration, the rotary, was initially included, but wide variation in design

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and lack of data precluded further analysis. Varying degrees of mechanization and parlor sizes were combined into thirteen model parlor configurations. For each of these modeled milking parlors, labor and performance standards were developed largely from published sources, including Bickert, Gerrish, and Hutt; Bickert, Gerrish, and Armstrong; and Armstrong, Speicher, and Bickert. These standards were later verified through empirical observation, and labor cost estimates were computed from the local milker's union Master Wage Agreement. Milking center construction cost estimates and milking equipment investments were synthesized from elemental component specifications and costs provided by local dairy contractors and equipment suppliers. Refrigeration and milk storage equipment investments were also obtained from local suppliers.

The feeding stage was analyzed in two parts. First, three alternative feeding programs were modeled with a linear program that maximizes income over feed costs (see Dean et al., for a discussion of the linear program). The typical feeding program was modeled as a single "commercial-mixed" ration fed in equivalent quantities to all lactating cows. Two group feeding programs in which form of feed differed were also modeled. One group feeding program modeled a single commercial premixed ration fed in different quantities to the various production/lactation groups. Alternatively, both ration composition and quantity fed were varied by blending bulk feedstuffs on dairy. Second, feed delivery and storage systems corresponding to the three feed programs were examined. Total feeding cost, the sum of feed costs, and feed storage and distribution costs were related to herd size.

Weather conditions in the study area dictate two housing facilities as relevant for analysis: dry-lot corrals and covered free stalls with adjacent loafing pen. Warm enclosed housing was not considered though free stall housing design features render the construction costs a close approximation. Construction cost estimates were synthesized from elemental component costs provided by local dairy contractors. Two corral sizes and three free stall sizes were modeled with design emphasis on the interaction among milking parlor design and size, feeding system, breeding and calf care, and general herd management.

Some costs of production cannot be allocated to a particular stage, but are common to several stages of production throughout the dairy. A general dairy cost category was specified to accommodate this situation. Such components as general dairy equipment, nonmilking labor, land, herd replacement, taxes and insurance, and miscellaneous variable costs were included in this category. Management, in the form of hired herdsmen, was included in the nonmilking labor component. Like other general dairy cost components, management was not considered homogeneous. Quality differentials required for alternative herd sizes were reflected in observed wage structure differences.

Synthesized Model Dairies

Specialized single enterprise dairies producing only market milk were synthesized from the detailed stage analysis. Fourteen single parlor design capacities ranging from 375 to 1,200 cow herds were modeled reflecting all capacity configurations within this range. Harmonious combinations of relevant milking parlor and housing configurations, feeding programs and rations, and equipment and labor complements yielded more than 200 model dairies at capacity. All dairies were organized to operate two complete milking shifts, thereby utilizing milking parlor capacity more fully. The herd size range was extended to 3,600 cows by structuring multiple parlor dairies as combinations of single parlor dairies organized around adjacent milking parlors.

Total annual dairy costs were computed under the various study specifications and restrictions by combining stage cost components (see Matulich, Carman, and Carter for a detailed discussion). Throughout the study, costs were related to output as measured by herd size.[1] Short-run cost functions were initially synthesized for single parlor dairies by varying the rate of operation. The LRAC curve was then derived as an aggregation of lowest short-run curves forming a discontinuous frontier. Enumeration of all relevant production techniques and single parlor capacities enabled explicit investigation of the potential discontinuities confronting large-scale dairies and added empiric meaning to the LRAC curve as a planning device.

Findings

The LRAC curve for single parlor dairies is presented in figure 1. Substantial economies of size were found over much of the 375 to 1,200 cow herd size range. Unit costs declined $64 per cow, from $1,056 to $992 for the 750-cow dairy. Approximately equivalent costs of $993 and $990 per cow were found for the 900 and 1,200 cow dairies, respectively. Milking parlor automation and better capacity utilization were the principal origins of efficiencies. Automatic detachers were found to lower significantly labor costs as compared with dairies em-

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[1] Published milking parlor performance data is indexed to an annual milk production level of 15,000 pounds per cow (representative production of well managed dairies in the study area). Given the production level and assumed proportion of lactating to dry cows (80:20), annual milk production can be measured. However, the impact of alternative production levels on parlor performance is unknown. Conversion to hundredweight of milk obscures this fact; cost per hundredweight is not invariant with respect to cow productivity. Alternative productive capabilities may alter the shape and position of the LRAC curve, but should not impact the technology mix.

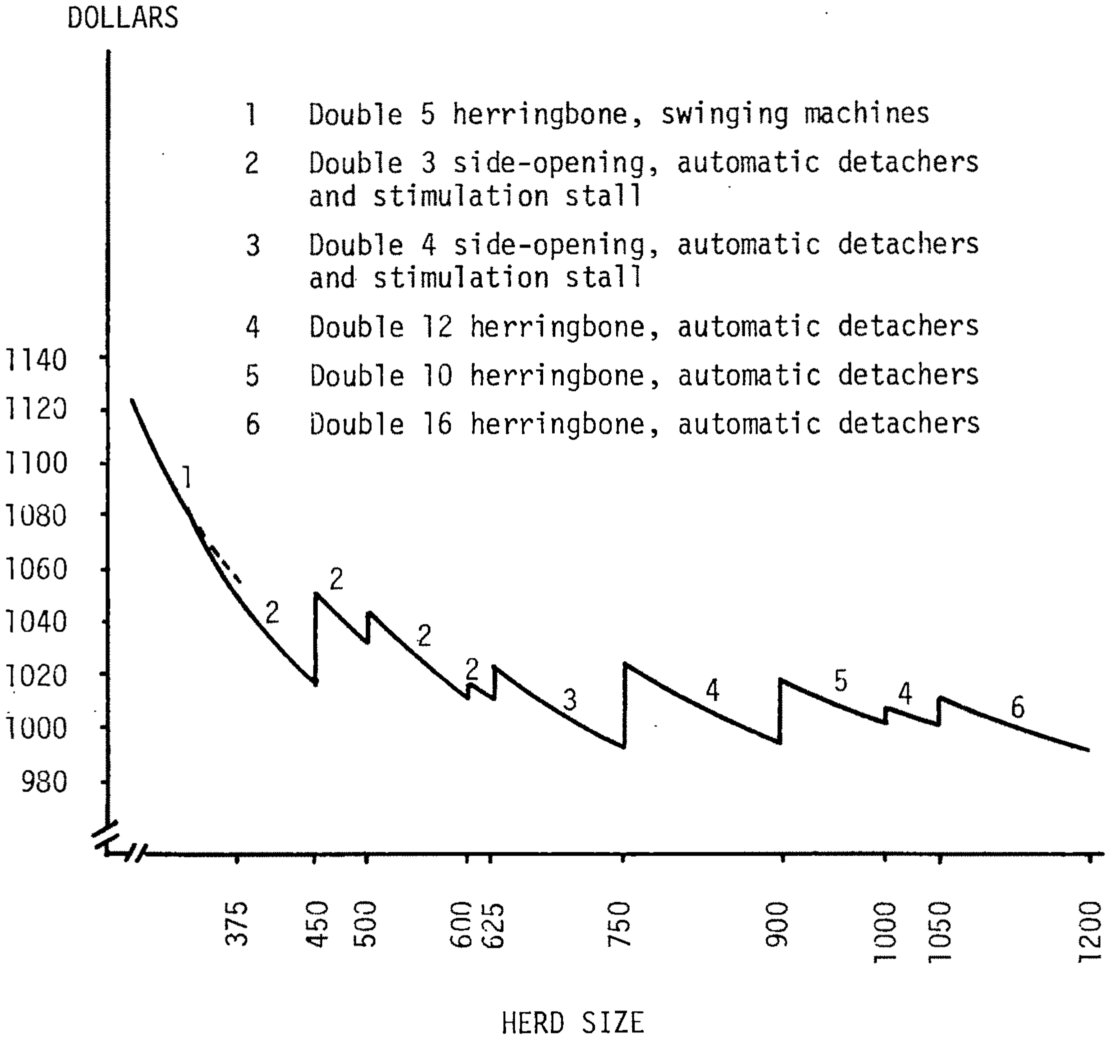

Figure 1. Long-run average costs as a discontinuous aggregation of short-run average cost curves for single parlor dairy configurations (excluding waste management)

ploying conventional milking machines. The large investment in automation, however, could offset gains in labor efficiency, especially for those dairies not on the frontier. Over 60% of available unit cost reductions were realized between the 375-cow herd (the only nonautomated dairy) and the 450-cow herd (the first herd size to employ automatic detachers). Further unit cost reductions to the 750-cow herd size result from better capacity utilization of the milking parlor in conjunction with changes in particular milking parlor configurations. All dairies on the LRAC curve utilized dry-lot housing which averages $25 to $30 lower per cow production costs than free stall housing.

Discontinuities in dairying are pervasive and originate ostensibly from changes in milking technique, housing configuration, and labor complement. For example, substitution of capital for labor is responsible for the 450-cow cost curve lying below the 375-cow cost curve. The two curves intersect as parlor configurations shift from a labor intensive double-5 herringbone parlor to an automated double-3 side-opening parlor. As capacity increases from 450 to 500 cows, unit costs rise even though the same milking technique is employed. This large discontinuity results almost entirely from an indivisibility in the outside labor complement. Dairies with capacity less than 500 cows do not hire outside labor, whereas one outside laborer is employed in the 500 to 999 cow capacity range. These rigidities are in response to institutional considerations imposed by local unions. Discontinuities between 500- and 750-cow dairies reflect indivisibilities in housing and milking systems. Additional corrals are necessary for each herd size and the parlor is enlarged over the 625–750 cow range. Beyond 750 cows, the milking parlor configuration takes a dramatic change from relatively small, automated side-opening parlors to large, automated herringbone parlors. This change is reflected in the attending discontinuity. Beyond 900 cows, unit costs again shift upwards as additional labor is required to relieve milkers from chasing cows. Unit costs return to a minumum as the excess labor capacity is more fully utilized.

Cost advantages of multiple parlor dairy configurations were found to be slight. Potential unit cost reductions, however, were available from (*a*) better capacity utilization of productive factors with excess capacity, and (*b*) limited opportunities to consolidate production activities by substituting larger more efficient technologies. In particular, general dairy equipment, refrigeration equipment, cow chasers, and management afford opportunity for better capacity utilization and consolidation. Together, these factors were estimated to yield a maximum additional cost advantage of $5 per cow for the 3,600-cow herd size, or equivalently, an average annual cost of $985. Problems of managerial coordination generally were not observed, though often cited as the main factor causing diseconomies of size. Two exceptions were noted, both of them in herd sizes greater than 2,500 cows. However, data precluded detailed analysis of management in these larger multiple parlor dairies.

Comparison of annual costs per cow by major category is presented in table 1 and reveals an important source of overall efficiency not apparent in figure 1. Eighty to eighty-five percent of annual costs are invariant with respect to herd size, including feed, herd replacement, land, and miscellaneous costs. While these categories do not affect scale economies, they are critical in determining the ultimate production cost level. The feed category, for example, accounts for 60% to 65% of all annual dairy production costs. Results from the feed stage analysis illustrate its contribution to overall dairy production efficiency. Regardless of herd size, group feeding according to production/lactation was found to be preferable to the traditional feed program; unnecessary over- or under-feeding is avoided by dividing the herd into groups with similar nutritional requirements. The optimal group feeding program (that of mixing bulk feedstuffs on-dairy) reduced annual feed costs approximately $50 per cow below the conventional constant level feeding program in spite of the additional equipment and labor requirements.

Relative component economies within the 375- to 1,200-cow range may also be determined from table 1. Construction costs decline 29% per cow, while equipment costs decline 32%. Taxes and insurance, which are derived directly from the preceding capital components, decline 16% per cow; unit labor costs decline 40%. These observed efficiencies correlate perfectly with specific technologies throughout the dairy system, and in general, should not be regarded as independent of the other categories. For example, much of the available labor efficiencies are attributable to changes in milking technology.

Conclusions and Implications

Significant economies of size were evident up to 750-cow herds. Costs per cow for 1,200-cow herds, the largest single parlor capacity modeled, were approximately equivalent. Larger dairies formed as combinations of two or more single parlor configurations exhibited little or no cost advantage through the 3,600-cow herd size.

Table 1. Total and Average Annual Costs per Cow for Least-Cost Single Parlor Dairies, by Herd Size and Major Component Categories: Construction, Equipment, Labor, Insurance and Taxes, Feed, Cows, Land, and Miscellaneous Variable Costs

			Average Annual Costs per Cow by Major Component Category							
							Constant per Cow Costs			
Herd Size	Total Annual Costs	Average Annual Costs	Construction	Equipment	Labor	Insurance and Taxes	Feed	Herd Replacement	Land	Miscellaneous Costs
Cows	$									
375	395,969	1,056	31.85	31.16	128.85	20.65	635.20	109.0	27.20	72.00
450	456,561	1,015	27.45	32.60	91.10	20.03	635.20	109.0	27.20	72.00
500	516,056	1,032	25.96	29.34	114.42	18.99	635.20	109.0	27.20	72.00
600	606,389	1,010	24.15	24.69	100.63	17.85	635.20	109.0	27.20	72.00
625	631,148	1,010	26.44	23.70	98.19	18.11	635.20	109.0	27.20	72.00
750	744,442	992	24.24	21.11	86.44	17.40	635.20	109.0	27.20	72.00
900	894,145	993	25.23	28.47	77.72	18.68	635.20	109.0	27.20	72.00
1000	1,000,700	1,001	23.59	23.27	92.93	17.51	635.20	109.0	27.20	72.00
1050	1,049,634	1,000	23.70	24.87	89.82	17.86	635.20	109.0	27.20	72.00
1200	1,187,762	990	22.67	24.22	82.06	17.46	635.20	109.0	27.20	72.00

Source: Matulich, Carman, and Carter.

These results contrast with previous studies (Peterson and Cook, Rafeld, Buxton and Jensen, Wysong, Martin and Hill, and Davidson). Economies of size were found for herd sizes five times greater than previously found. Recent advances in dairy production technology, particularly in milking and feeding systems, and better capacity utilization appear to afford greater overall production efficiency. However, direct comparison with the previous studies is tenuous. Most published cost studies pertain to relatively small multienterprise farming operations rather than the large, specialized, factory-type dairies analyzed in this study. Differences between the two dairy production methods are substantive.

The specific findings of this study are conditional on numerous factors contributing to a large-scale specialized dairy environment—a situation markedly different from much of the country. Three major characteristics distinguish industrialized dairying from that of small multienterprise dairying. First, the presence of a well developed feed market and distribution system is essential. Unlike much of the United States, a continuous supply of quality feedstuffs is commercially available in Chino. Feeds are hauled long distances from major cropping regions elsewhere in California. Success of large-scale dairy production in areas where a well developed feed market and distribution system does not exist is dependent on the relative efficiency of the commercial feed enterprise and the multienterprise dairy farm. Second, year-round availability of quality labor is essential to large-scale operations. Several local unions have organized the Chino dairy labor force, supplying highly skilled permanent and temporary milkers and general dairy labor. Third, the level of managerial and operational expertise required of industrialized dairying differs from small multienterprise operations. Management is highly specialized in the industrialized dairy as opposed to the diverse functions of the multienterprise owner-operator. To the extent that these factors can be attained, the LRAC curve presented in this paper provides an estimate of what is possible throughout much of the United States. Regional differences would likely modify the position, shape, and extent of available scale economies.

Under existing U.S. dairy industry structure, the LRAC curve derived in this study is representative of similar industrialized production regions, e.g., California, Arizona, Florida, and Texas, but the analysis offers potentially broad implications regarding future structural change throughout the U.S. dairy industry. The reported efficiencies are not limited to the exclusive domain of specialized dairies. Much of the technology contributing to economies of size is mobile. However, specialized management over each of the enterprises is essential to achieve comparable efficiencies. Moreover, the technological advances may be transferable to dairies smaller than examined in this study. Milking parlor automation, for example, may benefit small multienterprise dairies by releasing milker labor to alternative tasks, a situation not possible with complete specialization.

The structural change experienced during the ten-year period 1964–74 supports these implications. Average herd size increased as dairymen experienced opportunities to expand. It is apparent from census data that the majority of herd expansion occurred during the more recent five-year period 1969–74. Technological advances in milking parlor automation and feeding systems became available at this time. Realization of the broad applicability of these more recent technologies should enhance and even accelerate the expansion process. As one reviewer pointed out, though, factors associated with the short-run transition period may inhibit adoption of large-scale dairy production techniques.

Two important policy issues emerge from this conclusion. The first issue concerns the role of price supports and milk-marketing orders in promoting or deterring gains in production efficiency. The present administered pricing structure could foster inefficiencies by supporting small dairy enterprises while allowing windfall gains to larger producers. A related issue must also be raised concerning the social desirability of widespread structural change in the dairy industry. Though gains in production efficiency are potentially available, they are not without important distributional and social implications.

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The Economics of Adopting Solar Energy Systems for Crop Irrigation

Martin T. Katzman and Ronald W. Matlin

In the United States more than 35 million acres, or 10% of all farmland, is irrigated with the aid of energy-intensive pumps. Practiced almost exclusively west of the Mississippi, irrigated agriculture produces 20% of all output of the American farm sector and nearly 100% in states like Arizona and New Mexico (Dvoskin and Heady, Sloggett). About 2.5% of the nation's energy budget is devoted to on-farm activities; about 0.5% to irrigation (Council, Sloggett). While the energy expended on irrigation may appear small, it amounted to $520 million in 1974, or $15 per acre. What the averages belie is the critical importance of energy costs for irrigation in particular locations.

Price increases in fossil fuels and potential shortages of natural gas, the major source of energy in many irrigating areas, have aroused interest in alternative energy sources. Solar systems are of particular interest in agriculture for three reasons. First, pumping demands (to offset evaporation and transevaporation losses as well as to meet physiological needs of crops) are proportional to the supply of insolation. Second, the seasonality of irrigation demand (the duration of the peak varying from two months in Nebraska to eight months in California) induces many electrical utilities to institute stiff peaking fees. Third, the economies of scale in the generation of solar photovoltaic energy appear to be small; therefore, highly dispersed, small users can be served as efficiently as a concentration of large users.

This paper assesses the potential of solar photovoltaic technology for irrigation. First, the critical role of energy costs in arid regions is demonstrated. Second, the nature of solar photovoltaic systems and the technological, economic, and political uncertainties surrounding their adoption is discussed. Third, a parametric cost-benefit analysis identifies those contingencies to which the viability of the innovation is most sensitive. The numerical results presented for West Texas include the time of initial profitability, the time of optimal investment, and the pattern of tax incentives necessary to accelerate the rate of adoption.

Energy Costs in Arid Regions

The amount of energy consumed in irrigation depends upon the length of the growing season, the relative abundance of surface and ground sources of water, the depth of pumping for ground water, and to some extent upon pricing practices and costs of electrical utilities. The combination of these factors has resulted in the concentration of 70% of energy used for irrigation in Texas, Nebraska, Arizona, New Mexico, and California (Sloggett).

In addition to inducing water conservation and yield-threatening reductions in water use, rising fuel costs jeopardize the viability of irrigation and indicate a potential redistribution of agriculture to more humid lands, at least under conventional energy systems. The time at which conventionally powered irrigation becomes unviable can be computed through simple assumptions about land values and rents.

Agricultural rent equals the difference between operating revenues and operating costs, including returns to reproducible capital and entrepreneurship, at a particular site in its best and highest use (Katzman). Assume that prices and yields and, hence, revenues and other operating costs exhibit no long-term trend, but that fuel costs increase at the compound rate r after an energy crisis. Next, suppose that agricultural rents are approximately 3% of land values, or $i = .03$ (Ferraro). Irrigation becomes unviable in time when the increment in fuel costs above the precrisis level (F_o) equals the difference between irrigated and unirrigated land rents at their precrisis levels:

$$(1) \qquad (I - U)i = (F_o e^{rt} - F_o), \text{ or}$$

$$(2) \qquad rt = \log (F_o + Ii - Ui) - \log F_o,$$

where I is the precrisis value of irrigated land and U is the precrisis value of unirrigated land in a given region. Most likely, a shift from irrigated to nonirrigated agriculture involves a shift of crops, an eventuality taken into account in these calculations.

To illustrate the case of a typical arid region in West Texas, the precrisis values were $800 per acre for irrigated land and $100 per acre for unirri-

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gated land, while fuel costs were \$22 per acre. *Ceteris paribus,* if fuel costs rise at 2% per annum after the energy crisis, then $.02t = \log(\$22 + \$24 - \$3) - \log(\$22)$, and $t = 33$ years. Under conventional power sources then irrigated agriculture becomes unviable in 33 years. Doubling the rate of fuel escalation cuts the period of viability in half. As indicated by calculations for several western producing regions, Doomsday may be only a generation away at 4% fuel escalation rates (Matlin and Katzman, table 4).

Solar Photovoltaic Irrigation Systems

At noon on a clear day approximately one kilowatt of incident sunlight strikes a square meter of the earth's surface each hour. A module or cell in a photovoltaic system transforms this incident radiant energy into electricity at a conversion efficiency of 5% to 7%, a factor which probably will rise to 10% by 1985. In addition to differing from conventionally powered irrigation systems in the source of energy, solar-powered systems can operate only during daylight hours. To the extent that a certain rate of daily pumping is desired and that this rate exceeds the rate of recharge of the aquifer, additional wells may be necessary in a solar photovoltaic system. While this liability can be offset by the installation of batteries for powering the pumps during the night, the alternative is currently not cost effective.

The major economic difference between solar and conventional power systems is the phasing of costs. While conventional systems require a small investment in generating capacity (or none at all, if electricity is purchased from the central power grid) and continual annual expenditures for fuel, a solar photovoltaic system requires a massive front-end capital investment in modules and support facilities, but minimal operating costs. The adoption of a solar photovoltaic irrigation system, then, has the characteristics of any investment decision where a stream of benefits (in this case fuel savings) is compared to a capital cost.

For both the individual farmer and the policy analyst, assessment of the profitability of solar photovoltaic irrigation systems is subject to considerably more uncertainty than an ordinary investment decision. The technological uncertainties revolve around the performance characteristics of the module, in particular its conversion efficiency, durability, and maintenance requirements. The economic uncertainties involve the future stream of conventional fuel costs and anticipated capital costs of the system in the future. While these capital costs in any given year are known, a farmer may wish to postpone investment so long as the rate of technological improvement, measured in terms of cost per kilowatt generating capacity, is greater than the discount rate. There are also important policy uncertainties about the behavior of the federal government, private financing institutions, and electric utilities.

Social and Commercial Profitability

The profitability of solar photovoltaic irrigation systems is assessed for four representative producing areas, as defined by the Water Resources Council. These areas differ widely in their sources of water, depth or height of pumping, length of irrigation season, and magnitude of incident insolation during the year (Dvoskin and Heady). The analysis calculates the profitability of adopting the solar-powered system in each year from 1977 to 2000 on the basis of several combinations of assumptions. The analysis assumed year-round utilization of the energy; with capacity designed for peak irrigation demands, excess electricity is available off-season for crop drying, heating of livestock pens, residential supply, and possible feedback to the utility. On-season benefits account for 71% of the total in Texas, where there is a long irrigation season, but only 34% in Nebraska.

Cost Benefit Analysis

The profitability per acre of adopting a solar photovoltaic irrigation system on a farm is computed from equations (3)–(5):

$$NET_{Jk} = BENEFIT_{Jk} - COST_{Jk}, \tag{3}$$

where $j = 1$ in 1977, $k =$ region $1, \ldots, 4$;

$$COST_{Jk} = \{[X + (15{,}000 - X)e^{-J/\tau}] + Y\} {}^*A_k/E_f, \tag{4}$$

where the term in the brackets represents the cost per kilowatt of the arrays according to projections of the Department of Energy, X being the year 2000 target cost per peak kW; where the second term Y is the cost of supporting structures plus the difference in cost between conventional motor/generator and a solar-powered motor, battery, and DC-AC inverter costs; where A_k is peak kilowattage required to meet irrigation demands under insolation conditions documented elsewhere (Matlin and Katzman), and where E_f is the system electrical efficiency (taken to equal 0.9). Land costs of the arrays were ignored as they are trivial, i.e., an array generating one peak kilowatt utilizes only three-thousandths of an acre.

$$BENEFIT_{Jk} = \sum_{t=J+1}^{J+T} \frac{(CFI_{ko} + CFD_{ko} + RP_{ko} + RS_{ko}) {}^*e^{rt} + CM_{ko} - .01{}^*COST_k}{e^{t-J}}, \tag{5}$$

where $T = 20$, the presumed number of years in the lifetime of a solar energy system; CFI_{ko} is the cost of meeting irrigation demands under conventional fuels, priced initially at \$3.00 per million BTU; CFD_{ko}, the cost of meeting drying demands under conventional fuels at 2¢ per kWH; RP_{ko}, savings in residential purchases, assuming 30 kWH/day off-season at 5¢ per kWH; RS_{ko}, savings in residential purchases for heating or in sales of excess power to utilities at 2¢ per kWH, which is equivalent to the current cost of home heating oil. Annual system maintenance costs (CM_{ko}) are assumed to equal 1¢ per kWH output for the conventional systems and 1% of capital cost at 1986 prices (j = 10) for the solar-powered system. It is assumed that federal policy will result in a convergence in the price of all fuels on the basis of their BTU content at world levels, and that electric utilities will purchase excess electricity from farm homes at 40% of its selling price, which percentage reflects the approximate share of fuel consumption in electricity generation costs.

Four sets of parameters are applied to the analysis. First, the escalation in real fuel costs are assumed to equal, alternatively, 2% and 4%. Second, the discount rates are, alternatively, 3%, 5%, and 8%. Three percent represents the long-term, risk free, real rate of interest, such as that operative during the 1950s when prices were stable. Five percent represents the subsidized rate currently charged by the Farmer's Home Administration for forty-year real estate loans. Eight percent is the rate charged by that same agency for twelve-year equipment loans and the unsubsidized rate charged by the Farm Credit System for thirty-year mortgages. Third, the target arrays costs are \$500/kilowatt (pk) in 1986 and bounded by \$100 and \$300 in the year 2000. Fourth, system support costs are \$546 or \$1052/kilowatt (pk), as estimated in Matlin and Katzman (table 7).

The numerical results for Arizona (WRC producing region 87) and the Central Valley of California (WRC producing region 101) are nearly identical to those for West Texas (WRC producing region 79), which can represent the entire Southwest. The costs and benefits of all scenarios are graphed in figures 1 and 2. The solid, downward sloping lines represent costs; the dashed, upward sloping lines, the present value of benefits in each year of invest-

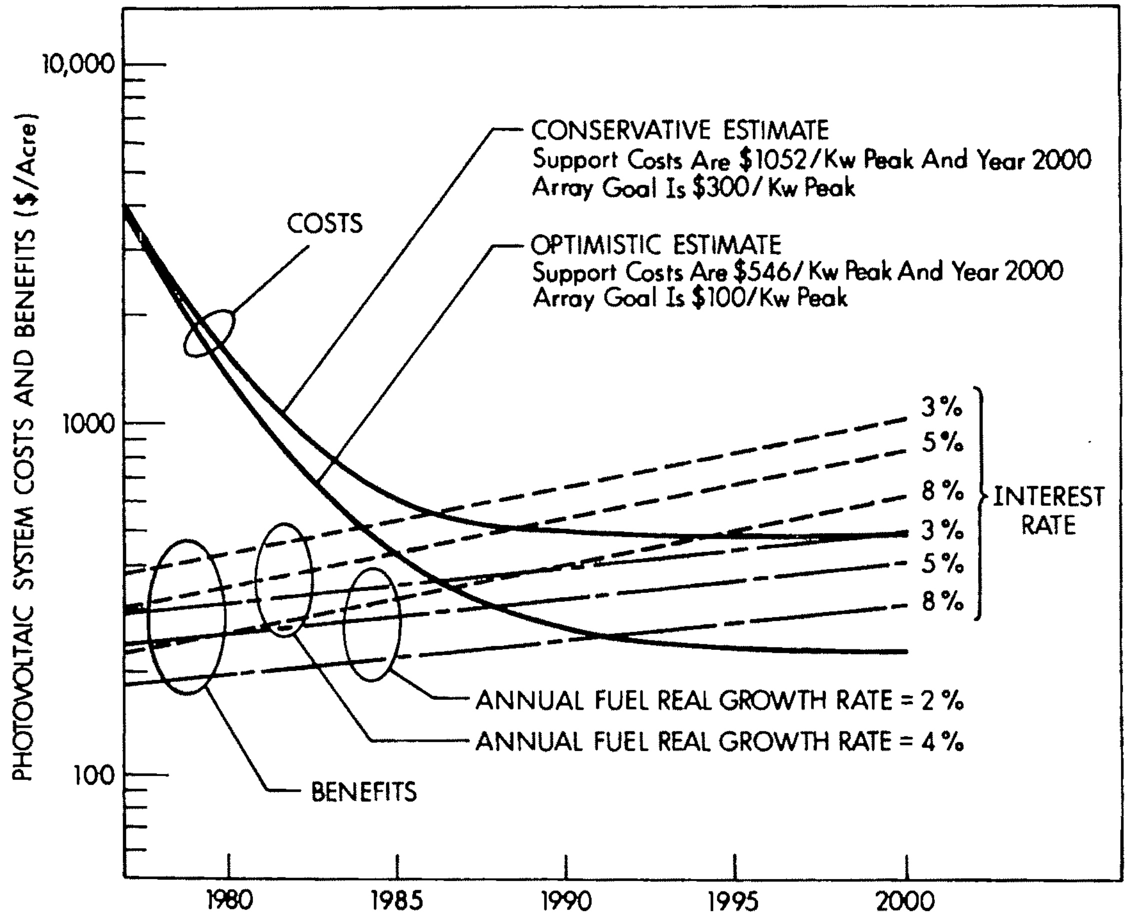

Figure 1. Photovoltaic system costs vs. benefits (per acre)—Nebraska, 1977–2000

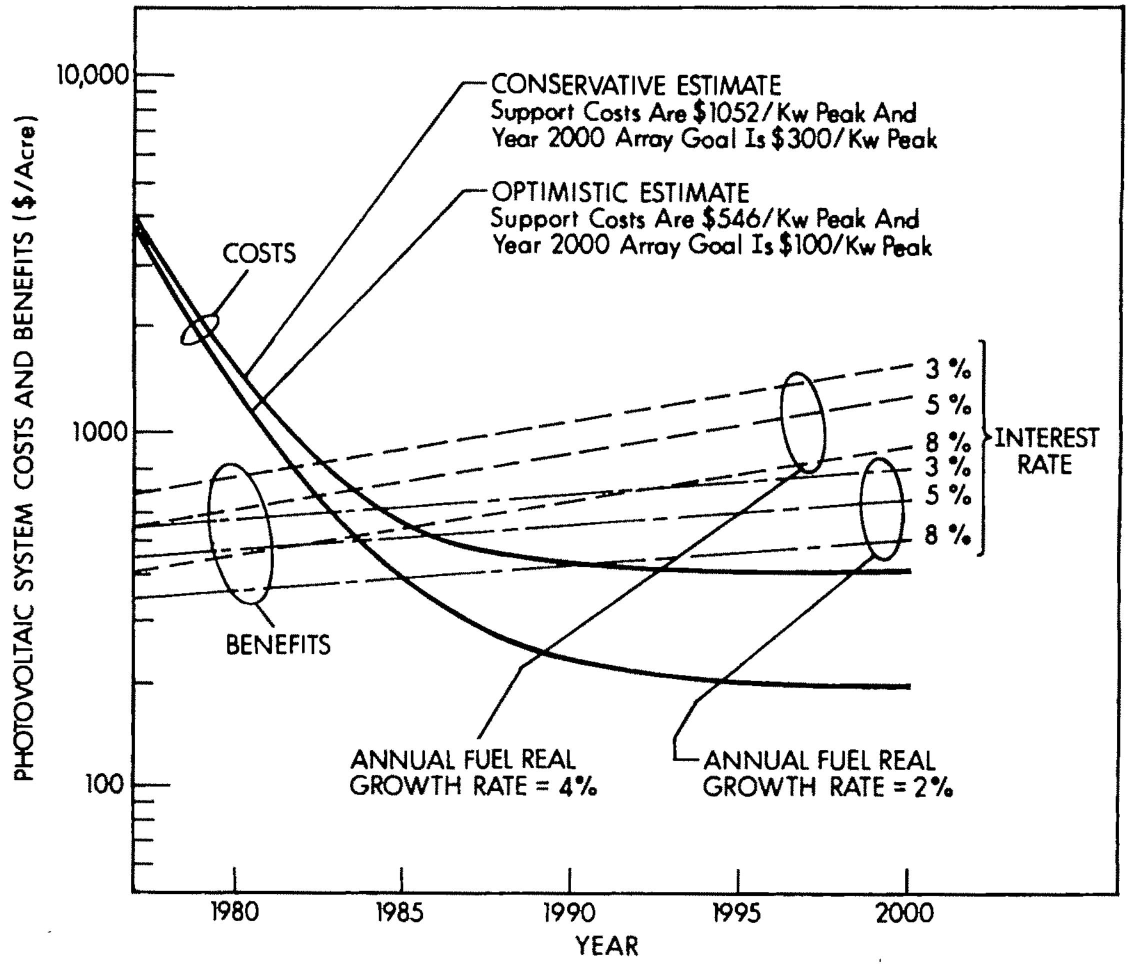

Figure 2. Photovoltaic system costs vs. benefits (per acre)—Texas, 1977–2000

ment. If the cost of solar photovoltaic arrays follows DOE's projections, solar energy for irrigation purposes will become profitable in the early to middle 1980s in the Southwest and Great Plains. These results are remarkably robust and insensitive to variations in discount rates, fuel inflation rates, or level of target costs in the year 2000.

Under each of the sets of assumptions, solar energy for irrigation becomes profitable earlier in Texas than in Nebraska. Reducing the fuel inflation rate from 4% to 2% postpones the viability of solar irrigation by about one or two years in the Southwest but somewhat longer in Nebraska.

Under an optimistic scenario (5% discount rate; 4% fuel inflation rate; year 2000 target level, $100; system support costs, $546/kilowatt) the use of solar photovoltaics in irrigation becomes profitable by 1983 in Texas and 1986 in Nebraska. Under the most conservative scenario (8% discount rate, 2% fuel inflation rate, year 2000 target level, $300, and system support costs, $1052/kilowatt) the use of solar photovoltaics becomes profitable by 1991 in Texas, and after the year 2000 in Nebraska. For all scenarios, solar systems become profitable well before irrigation itself becomes unviable in these states, as calculated above. The year at which solar photovoltaics becomes viable under several scenarios in Texas is indicated in table 1, column (a).

It should be noted that the year in which solar photovoltaics become profitable in irrigation is not identical to the optimum year. Because the cost of arrays is expected to decline rapidly during the 1980s, the postponement of the purchase of arrays can result in an increase in net benefits. The rule for determining the optimum year for the investment is to select the year h, in which net benefits discounted to the present are maximum

$$(6)\quad \max PRESENT\ VALUE\ (h) = NET\ BENEFIT_h/e^{ih},$$

where $h = 0$ in 1977, and i is discount rate.

Returning to the optimistic and conservative scenarios, one finds that the optimal time of investment is approximately seven years after solar photovoltaics become commercially profitable. In a

Table 1. Texas, 20-Year Investment Period, Array Target Cost of $300/kw

			(a) Cost-Benefit Basis	(b) Cost-Benefit Basis	(c) Commercial Basis	(d) Commercial Basis
Initial Support Cost $/kw	Annual Rate of Increase of Fuel Cost	Discount Rate	Year of Viability	Optimal Year	Year of Viability	Optimal Year
546	.02	.03	1983	2000+	1983	1996
		.08	1986	1991	1984	1989
	.04	.03	1982	2000+	1982	2000+
		.08	1984	1990	1983	1989
1052	.02	.03	1985	2000+	1984	2000+
		.08	1991	2000+	1987	1995
	.04	.03	1983	2000+	1982	2000+
		.08	1985	1997	1984	1992

few cases, where the discount rate is less than the fuel growth rate (an unlikely event), the optimal year lies beyond the year 2000. If fuel rates increased faster than the discount rate, owners of fuel resources would maximize their wealth by storing rather than extracting. The result would be a once and for all price increase that would induce fuel production (see Weinstein and Zeckhauser). Under the optimistic scenarios, the optimal year of investment in arrays is 1997 in Texas and after 2000 in Nebraska. Under the conservative scenario, the optimal year of investment is after the year 2000 in both states. The optimum year for each scenario is indicated for Texas in table 1, column (b).

Commercial Viability

The farmer's commercial calculations differ from the above by the consideration of the tax deductibility of both fuel charges and interest payments on arrays as well as by the accelerated depreciation allowance. Here we assume that 100% level-payment financing is available for the life span of the arrays, over which they are depreciated on a sum-of-years-digits basis; and that the farmer is taxed at R, the marginal rate of 20%. Let I_t stand for interest payments, A_t for amortization, B_t for annual benefits as computed above, D_t for annual depreciation, and i for the discount rate, here the lending rate. An investment tax credit of 10% is also assumed for the entire value of the investment.

The present value of an investment in solar arrays equals

$$(7)\quad PV_j = (1 - R) \sum_{t=j+1}^{j+T} \frac{B_t - I_t}{(1 + i)^{t-j}} + R \sum_{t=j+1}^{j+T} \frac{D}{(1 + i)^{t-j}} - \sum_{t=j+1}^{j+T} \frac{A_t}{(1 + i)^{t-j}} + 0.1^{*}COST_j.$$

Taking taxes and financing into account generally shortens the period before which solar systems are viable. Under the conservative scenario, the year of viability is brought forward four years in Texas, but viability still lies beyond the year 2000 in Nebraska. Under the optimistic scenario, viability occurs less than one year earlier in both states—table 1, column (c).

It should be noted that these results are somewhat sensitive to maintenance costs. While the present results assume that maintenance costs equal 1% of total system costs (at 1986 prices), simulations with 2% maintenance costs were also tried. The higher maintenance costs add one to two years to the year of viability.

Conclusion and Policy Implications

The economic comparison between conventional and solar photovoltaic energy systems for irrigation suggests that the latter will become profitable in the middle to late 1980s if the cost of solar modules follows DOE projections. These results are remarkably robust and insensitive to reasonable variations in discount rates, fuel escalation rates, and support system costs. Not surprisingly, solar-powered systems become viable earlier in those areas with larger amounts of year-round insolation and/or longer irrigation seasons. Because of the expected continual decline in the costs of solar modules to the year 2000, the optimal year of investment is later than the initially viable year.

Public policy is currently operating on both the supply and demand side for solar photovoltaics. On the supply side, DOE is financing the purchase, and indirectly subsidizing the production, of solar cells. This should facilitate the attainment of its cost targets through the realization of economies of scale and learning by doing on the part of suppliers. On the demand side, field tests, such as those being undertaken by MIT/Lincoln Laboratory in conjunction with the University of Nebraska-Lincoln (Matlin, Romaine, Fischbach) can reduce some of the uncertainties of the system, particularly with respect to reliability and maintenance costs, which here were estimated by rules of thumb.

The curve of net commercial profitability, discounted to the present, around the optimal year is quite flat (figure 3). For example, the optimal year of innovation under the most conservative assumption is about 1993 in Texas. In Texas the present value of the net benefit one year before the optimum is less by only 0.2% of the cost of the investment. In other words, an additional tax credit of 1% over the present 10% could accelerate adoption by one year. The necessary additional tax credit to accelerate adoption by two years is only about 2%; by three years, about 5%; by four years, about 10%; and by five years, about 16%. This suggests that federal tax credits can have considerable leverage on adoption.

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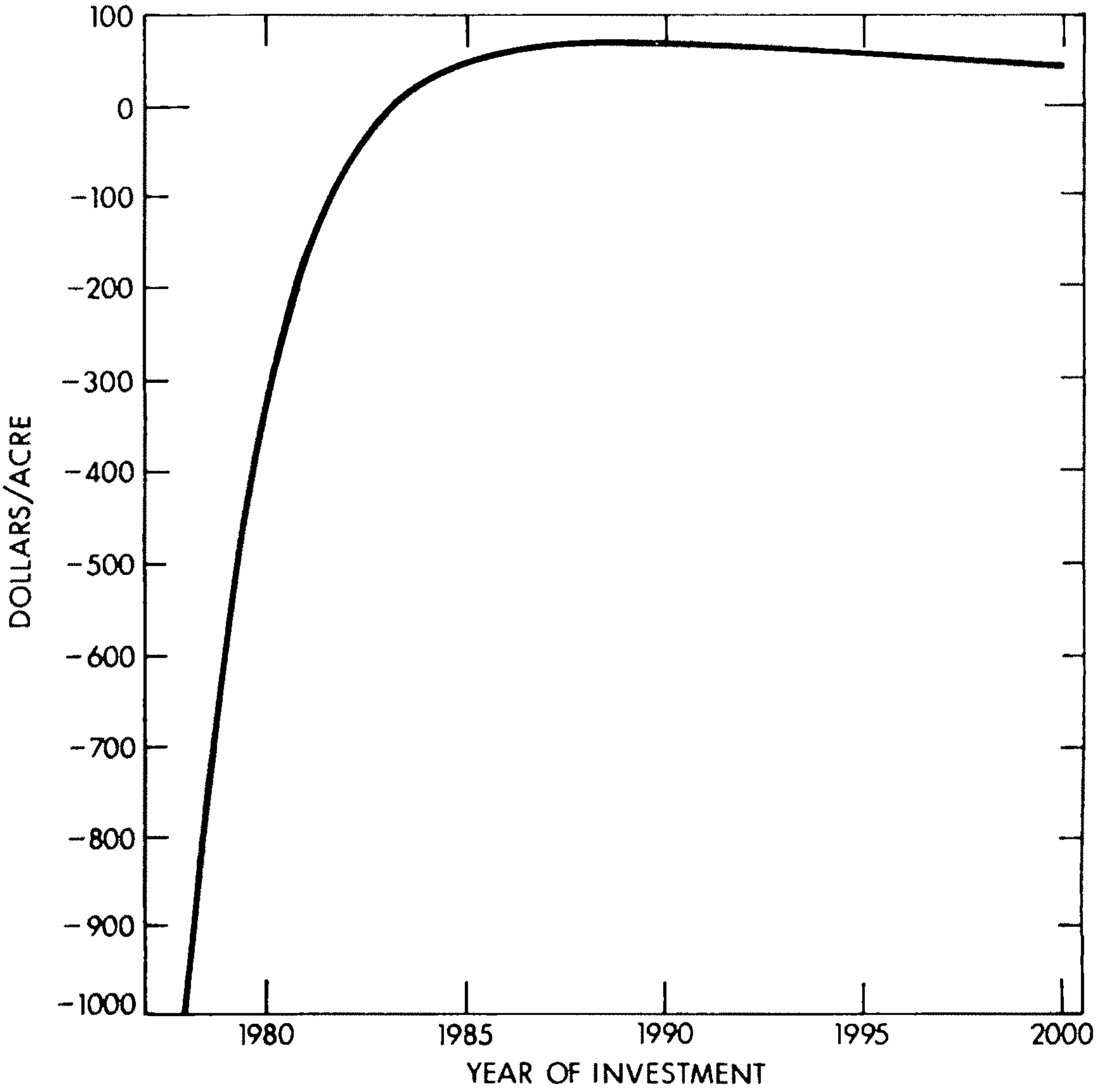

Figure 3. Net commercial benefit of photovoltaic system brought forward to 1977, conservative scenario—Texas

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Tobacco Technology and Agricultural Labor

Philip L. Martin and Stanley S. Johnson

At the founding of the American commonwealth two hundred years ago, 95% of the population was engaged in agriculture. Today, less than 4% of the labor force remains in agriculture, the result of a massive shift of labor from the farm to the nonfarm sector. From a historical perspective, the agricultural changes which displace substantial numbers of farmworkers are nearly complete; estimates indicate that the share of the labor force in agriculture is expected to decline to 2% by 1985 (U.S. Dep. of Labor, p. 336).

Just as agriculture has slowed the rate at which it disgorges its surplus labor into the nonfarm sector, renewed concern for the consequences of some agricultural changes is being expressed. The public agricultural research establishment is indicted for neglecting the human costs of the labor displacement which often accompany mechanization, for accelerating the pace of environmental and rural decay, and for encouraging the production of profitable but less palatable crops (California Assembly, Hightower). Although the values of critics may be questioned and the cogency of specific indictments disputed, the conflict between the drive for agricultural efficiency and the needs of farmworkers, the environment, and consumers promises to be prominent in the set of issues which "seem likely to broaden and intensify" (Farrell, p. 786) rather than disappear. The absence of informed debate on the relative virtues of agricultural efficiency and workplace equity obscures the real interdependency between the social goals of efficiency and equity, permitting the enactment of incompatible policies designed for what are actually joint problems.

This paper examines the benefits and costs which can be expected as a result of mechanizing the harvest of one of the most labor-intensive crops in America, flue-cured tobacco.[1] In 1972, about 141 million man-hours, 3% of all man-hours used in the production of crops, were used to produce flue-cured tobacco on 0.5 million acres of land in the Southeast (Grise et al., p. 22; U.S. Dep. of Agriculture, p. 99). Most flue-cured tobacco labor (60%–70%) is used in the six-to-eight-week harvest. Although mechanical innovations introduced since World War II already have reduced harvest employment, the introduction of the mechanical harvester and adoption of bulk barns is further reducing harvest labor demands. The mechanical tobacco harvester, developed with public monies, serves as an illustration of the research-displacement nexus in agriculture and permits the exploration of the various policy options available to alter the linkage.

After a brief description of technological changes in the flue-cured tobacco industry, we derive an estimate of the average annual return which can be expected as a result of past and ongoing research outlays. In the third section of this paper, we explore the magnitude of potential adjustment costs likely to be incurred by displaced harvest labor. In the concluding section, we review the prospects for successfully implementing any of the proposed compensation or assistance schema. Throughout the paper, our focus remains on the efficiency-equity conundrum. While no ideal solution appears available, it is hoped that a discussion of the need for solutions can generate more research on a timely issue.

Estimating Returns to Harvest Mechanization

The production of flue-cured tobacco has been altered by changed technologies, management practices, and tobacco program features for the past thirty years. One impact of the series of changes that has occurred is a reduction in labor needs; in 1970, tobacco labor requirements were only one-third of their 1947 levels (Hoover and Perkinson, p. 11). Since the tobacco harvest requires three "stages," viz., leaf removal, preparing leaves for curing, and curing, tobacco harvesting can utilize alternative "harvest systems." At least ten harvest systems are currently in use, ranging in complexity from hand to various degrees of mechanical harvesting (Grise et al., p. 13).

One innovation which facilitates adoption of the

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[1] More precisely, this paper focuses on one aspect of adjustment costs, the costs to those whose labor time is made redundant by the diffusion of a mechanical tobacco harvesting system. While we are cognizant of the existence of other costs, e.g., capital adjustment costs, our estimates are confined to labor's adjustment costs because labor is the only factor for which policy makers have considered compensation.

mechanical tobacco harvester is the replacement of the dominant method of curing tobacco, the conventional curing barn, by the bulk curing barn. The traditional method is to cure tobacco in wooden (conventional) barns, using hand labor to tie the leaves to sticks. The bulk barns have metal racks into which untied leaves can simply be stuffed for curing, saving considerable labor. Bulk curing barns can be utilized with both hand and mechanical harvesting systems, although only the latter requires the bulk barn. Between 1972 and 1980, bulk barns will be adopted by most flue-cured tobacco growers (Hoff et al., p. 13).

In 1954, the Department of Agricultural Engineering at North Carolina State University began research on ways to remove mechanically mature tobacco leaves. The breakthrough came in 1963, when it was realized that serrated rollers could break off leaves at a preset height (stage of maturity) and then be raised for subsequent leaf harvests. In this way, several leaf picking passes were possible without destruction of the tobacco plant itself. The leaves are deposited in attached bins, from which they are transferred to the bulk barns for curing. Prototype mechanical leaf harvesters were manufactured as early as 1963, but the machine's cost, wastage, and the availability of low wage labor slowed adoption; in 1972, mechanical harvesters were in commercial use on less than 1% of the acreage (Grise et al., p. 13).

Use of a mechanical leaf harvester in conjunction with bulk curing barns dramatically reduces harvest labor requirements. The 1972 mix of premechanical harvest systems, largely using conventional curing barns, required an average labor input of 186 man-hours per acre, while the mechanical harvester and bulk barn required a harvest labor input of only 58.7 man-hours per acre (Grise et al., p. 18; Hoff et al., p. 7). Although mechanical harvesting is undergoing further development, current technology seems likely to have the primary impact on harvest labor use.

One framework for estimating returns to public research investments has been developed by Peterson from Griliches. An application to appraise social costs as well as social benefits in the context of agricultural harvest mechanization was presented by Schmitz and Seckler and adapted by Johnson and Zahara using consumer's and producer's surplus and various compensation proposals. This method is adopted with returns to research calculated in two ways, the excess present value method (EPV) and the internal rate of return (IRR). The EPV is that present value of future net cash inflows which is in excess of the investment outlay; or, the investment has a positive excess value if

$$\sum_{t=1}^{n} NR_t(1 + r)^{-t} - \text{outlay cost} > 0,$$

where r is the firm's cost-of-capital rate, and NR_t is net cash inflows in period t. The IRR is the implicit rate of return on investment, or the interest rate that will discount the net cash inflows back to a present value equal to its investment outlay, or

$$\sum_{t=1}^{n} NR_t(1 + r')^{-t} = \text{outlay cost},$$

where r' is IRR.

Gross social returns include all benefits and costs, external as well as internal. A part of the external costs, the wage loss to displaced workers, is estimated separately and included in the computation of "net" social returns. All returns are assessed against discounted research and development costs. The equation is

$$\frac{\textit{Gross Social Rate of Return}}{(\textit{GSR})} = \frac{\textit{Total Annualized Value of Gross Social Returns}}{\textit{R and D Costs}}(100),$$

and

$$\frac{\textit{Net Social Rate of Return}}{(\textit{NSRR})} = \frac{\textit{GSR} - \textit{Annualized Labor Costs of Displacement}}{\textit{R and D Costs}}(100).$$

The measurement of social benefits and costs is complicated because of the multiplicity of flue-cured tobacco harvest technologies. The primary complication emanates from the role of bulk-curing barns. Bulk barns are necessary for mechanical harvesting but they also provide significant labor savings when used with hand or other nonmechanical harvester leaf-harvesting methods. To separate the labor savings due to the harvester from those arising from bulk barn usage, harvester benefits are defined as the difference between the average hand harvest costs with bulk barns and the average harvest cost with mechanical harvesters.

In order to obtain point estimates of returns, several assumptions are necessary. A 1972 survey of flue-cured tobacco farms (Grise et al.) provides estimates of the mix of harvest labor systems in use and their respective man-hour requirements. The 1972 survey year serves as the base year for the calculation of benefits and costs, and in this analysis it is assumed that tobacco production will remain at the 1972 level.

Diffusion rates for the mechanical harvester are difficult to establish. In 1972, up to 1% of the acreage was machine harvested (Grise et al., p. 13). By 1975, it was estimated that some 2,000 machines were in use (Givan and White, p. 1). A recent publication estimates that 30% of total production will be mechanically harvested by 1980 (Hoff et al., p. 13). The period from 1972 to 1980, when machine harvesting is expected to increase from about 1% to 30.1% of production, serves as the base period for predicting future diffusion. On an annual average basis, the machine is expected to diffuse at a rate of 3.76%.

The estimated mix of harvest technologies using bulk barns but not mechanical harvesters was based on a 1980 projection for two general types of harvest systems: two hand harvest and two riding primer systems. Of these systems, about 72% are expected to be hand harvest and the remaining 28% riding primer (Hoff et al., p. 13). The average investment outlay and operating costs of the harvesting systems were calculated from data in Grise et al., pp. 25, 36–39. Harvest operating costs for both nonmechanical and mechanical harvester systems were averaged over four sample flue-cured production areas with the costs weighted by each area's share of production. Finally, costs were averaged for the hand harvest and riding primer systems and weighted by Hoff's diffusion estimates for 1980. The mechanical harvester system investment outlay was estimated to be $1,307 per acre, which is $216 greater than the $1,091 investment per acre for the weighted average of the nonmechanized harvesting systems. The average annual operating cost of the nonmechanized systems was $348.49 per acre, compared to an average cost of $259.86 per acre for mechanical harvesting, resulting in a cost savings of $88.63 per acre.

Machine harvesting was assumed to begin in 1972 at the 3.76% annual adoption rate on 19,312 acres per year (513,620 acres of flue-cured tobacco × 3.76%). At that rate, adoption would be completed in twenty-seven years, or by 1999. The present value of the cash flows from the difference in investment outlays and operating costs between nonmechanized and machine systems was calculated for each "cohort" (adopting group), i.e., for each of the twenty-seven annual increments of 19,312 acres. The machine system investment for that acreage totalled $4.96 million, while that for the nonmechanized systems was $0.78 million. Annual operating savings totalled $1.712 million.

Average equipment service life was estimated to be eight years for the mechanical harvester and ten years for the mix of nonmechanized technologies (Grise et. al., p. 25). It is assumed replacement occurs at the end of the service life with no salvage value. An initial period of forty years was used for investment analysis because the service lives of both equipment types end in that period. Initial investment and periodic reinvestment comparisons for one cohort are presented in table 1. The first cohort has an initial net investment of $4.18 million, followed by subsequent reinvestments of $4.96 million every eight years and $0.78 after ten years.

Table 1. Flue-Cured Tobacco Mechanical Harvester Net Cost Savings from Investment, Reinvestment, and Annual Operating Costs

	Investment: Hand-Machine Technology Cash Flows	Annual Operating Cost Savings: Hand-Machine Cash Flows
	$ Million	
	−4.18	
1972		1.712
3		1.712
4		1.712
5		1.712
6		1.712
7		1.712
8		1.712
9	−4.96	1.712
1980		1.712
1	0.78	1.712
2		1.712
3		1.712
4		1.712
5		1.712
6		1.712
7	−4.96	1.712
8		1.712
9		1.712
1990		1.712
1	0.78	1.712
2		1.712
3		1.712
4		1.712
5	−4.96	1.712
6		1.712
7		1.712
8		1.712
9		1.712
2000		1.712
1	0.78	1.712
2		1.712
3	−4.96	1.712
4		1.712
5		1.712
6		1.712
7		1.712
8		1.712
9		1.712
2010		1.712
1		1.712
2012		

Note: The 40-year investment cycle for 3.76% adoption in year 1972 only, for 19,312 acres (the first cohort). Each succeeding cohort will proceed through a similar cycle.

The present value of the cost savings attributable to the adoption of the mechanical harvester was calculated in three successive steps:

$$\left[\sum_{t=0}^{40}\frac{NR_t}{(1.09)^t}\right]\left[\frac{(1+r)^{40}}{(1+r)^{40}-1}\right]\left[1+\sum_{t=1}^{26}\frac{1}{(1.09)^t}\right].$$

The initial calculation of the left-hand term is the present value of the first forty expected annual net cash flows associated with mechanical harvesting, less the present value of the first forty expected annual net cash flows associated with non-mechanized harvesting, for the cohort that mechanizes in 1972 (year 1). The product of the left and middle terms is the present value of the difference between the two sequences of expected net cash flows over all future years for the first cohort.[2] The product of all three terms is the present value of the difference between the two sequences of net cash flows over all future years for all cohorts. The EPV of the stream of benefits to the harvester, discounted at 9%, totalled $126.3 million. This sum is equivalent to an annual return (annuity) of $11.37 million per year.

The basic principles governing the mechanical removal of tobacco leaves were developed by researchers between 1954 and 1963. Expenditures were low, averaging only $10,700 per year over the ten-year period—merely the part-time salaries of one professor and a research assistant. Including indirect research costs, first-phase (1954–63) research costs have a 1972 value of $780,000 (table 2). After 1963, research was conducted by both private firms and public institutions; the 1972 value of such research totalled $2.22 million. Efforts to refine and improve harvester efficiency continue; the 1972 value of future research outlays from 1972 to 2092 (at $250,000 per year) is expected to total $2.78 million. Thus, the total research bill between 1954 and 2092 is $5.78 million, or about 50% of the annual value of the benefit flow.

The gross social rate of return (*GSRR*) was estimated as (table 2):

$$GSRR = \frac{11.37}{5.78}(100) = 197,$$

or a 197% annual return over time. In addition, calculation of the IRR indicated an internal rate of return of approximately 28%.

Table 2. Gross Social Returns to Tobacco Harvester Development, 1972 Values

Benefits	Million dollars
1. Total benefits, 1972–2022	126.3[a]
2. Annual value of benefits	11.37
Costs	
1. Public expenditures, 1954–63	0.78
2. Public expenditures, 1963–72	0.80
3. Private expenditures, 1963–72	1.42
	3.00
4. Public and private expenditures, 1972–2092	2.78
Total	5.78

[a] All data are discounted @ 9%.

Sources: Correspondence from C. Suggs, North Carolina State University, Department of Agricultural Engineering, and text references.

Expected Adjustment Costs and Net Social Returns

Given expected diffusion rates, the mechanical tobacco harvester is expected to reduce total employment in the flue-cured tobacco harvest at an annual rate of 1.1 million man-hours per year. Gross adjustment losses to displaced workers are dependent on the value of the lost earnings which cannot be immediately replaced. Annual wage loss estimates are derived from the average 1972 wage rate of $1.39 per hour (Grise et al., p. 22), or 1.1 million man-hours × $1.39 = $1.53 million. Over time, the discounted total value of anticipated foregone earnings as a result of mechanical harvester usage totals $17.0 million.

Because harvest labor requirements are specified in man-hour rather than person units, no precise estimate of the number of persons engaged in tobacco harvesting exists. If the annual estimates of man-hour displacements are divided by average individual effort levels, an estimate of the number of individuals displaced each year can be obtained. The tobacco harvest occurs over a six- to eight-week period; if each laborer contributed six ten-hour days over a seven-week period, the average effort would be 420 man-hours per person per season. But laborers cannot work full-time in the harvest season—because leaves ripen in the course of the harvest, there is a waiting time between pickings. Seasonal work hours are estimated to be 256 per individual (Hoover and Perkinson, p. 24), implying that the harvester will displace an average of 4,297 individuals annually.

Estimates based on 1972 surveys show that about two-thirds of the harvest labor is supplied by seasonally hired workers (Grise et. al., Hoover and Perkinson). The impact of mechanization will be most directly felt by this hired work force, especially the younger workers and women who perform much of the harvest labor under conventional harvest systems.

After being displaced, it is assumed that redundant labor attempts to replace a lost earnings stream, although evidence concerning the speed of income replacement is lacking. In this study, it is assumed that seasonal tobacco harvesters lose 100% of tobacco earnings in the year of displacement and succeed in replacing 100% thereafter, i.e., income losses are confined to the year of displacement. Displacement costs vary across individuals as to (*a*) individual dependence on the tobacco harvest for income, and (*b*) the ease or difficulty in replacing lost tobacco earnings. In one household study of an eight-county area of North Carolina in 1972, earnings of hired workers averaged \$340 per harvest, and comprised an average of 75% of total annual earnings (Hoover and Perkinson, p. 31). However, this survey determined that for the average hired worker household, the harvest accounted for only 8% of income (p. 52), implying that the harvest labor force in the study area was dominated by those whose only labor force participation was during the tobacco harvest or those deriving only supplemental income from tobacco harvesting. To the extent that this area was typical of all flue-cured tobacco areas, harvest earnings are only a small part of family income. Since the young workers are likely to be the first displaced, adjustment difficulties, as measured by total income losses, could be minimal.

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[2] In some industries, unions can create job property rights and extract compensation for job displacement. Although the common law has been construed to regard union demands for the replacement of machines with men as unlawful ("for a union to insist that machinery be discarded in order that manual labor may take its place and thus secure additional opportunity of employment is not a lawful labor objective." General Teleradio, Inc. v. Manuti, 133 New York State 2nd 362), statutory labor law does not proscribe "excess" employment or featherbedding. Section 8(b)6 of the Taft-Hartley Act (1947) makes it an unfair labor practice for a union to "cause an employer to pay . . . for services not performed." Even though printers were paid to set "bogus" type, i.e., typesetting which was useless to the newspaper, the Supreme Court held that the willingness of the employer to pay for "useless work," even if forced to do so under threat of labor unrest, is *prima facie* evidence that both bargaining parties found the arrangement more useful than its alternative(s).

In compiling average earnings losses as a result of displacement, it is recognized that some distribution of gainers and losers characterizes actual experience. If net social returns are estimated using only the summation of average losses method, they will reflect only a pecuniary compensation test where dollar weights are equal; e.g., if one individual obtains year-round manufacturing work and increases his income by \$5,500, he will offset the (average) \$340 losses suffered by sixteen others displaced. On this average loss basis, a net social rate of return (*NSRR*) is estimated by the EPV equation:

$$NSRR = \frac{GSR - \text{Annual Wage Losses}}{R \,\&\, D \text{ Costs}} (100)$$

$$= \frac{11.37 - 1.53}{5.78} (100) = 170.$$

Thus, consideration for average adjustment losses reduces gross returns from 197% to 170%. Calculation of the IRR showed a reduction from 28% to 22%.

Net social returns, although reduced by adjustment losses, are high relative to the returns thought to accrue to alternative social investments. Even the assumption of gross adjustment losses shows net annual social returns to mechanical harvesting research of 170%, a rate of return far in excess of the assumed 9% opportunity cost of funds. It is clear that alternative assumptions which increase the discount rate and/or alternative estimates of adjustment costs could further reduce the *NSRR*, but even (non)marginal reductions in *NSRR* would leave mechanical harvesting research an attractive social investment.

Agricultural Mechanization and Public Policy

The mechanization of the tobacco harvest illustrates the conflict between two social goals. Measures to increase agricultural efficiency require adjustments, adjustments whose costs are often borne by one of the least privileged segments of society. If benefits and costs of tobacco harvest mechanization are estimated, it is clear that no reasonable definition of adjustment costs will reduce estimated benefits from agricultural research enough to suggest that outlays be redirected. But costs do exist. The question remains, do displaced harvest workers deserve compensatory payments, i.e., payments in addition to any social welfare benefits available to all low income persons?

There are several forms of compensation, each with its own (implicit) identification of the culpable force in displacement. Some argue that all those displaced should be aided by active manpower policies (Bakke), that the source of need for assistance is irrelevant. At the other extreme, it can be argued that farm workers have "property rights" in their tobacco-harvesting jobs, entitling them to compensation because of (implicit) public policies which lead to their displacement.[2] Others would go still further and require the issuance of a social impact statement before publicly subsidized research which might result in displacement is even undertaken. If labor could be adversely affected, some have argued that public monies could not be expended until compensation or assistance arrangements are made available. Thus, policy prescriptions range from (*a*) no changes to (*b*) better manpower and mobility programs to (*c*) compensation after displacement to (*d*) accounting for displacement before undertaking research and implementing remedial actions.

The first two policies require few institutional changes; the first merely continues current practices, while the other implements a manpower goal widely embraced by policy makers. If compensation policies were adopted, a host of issues would arise. If payments were made, how much should be paid; one-half last year's earnings, 100%, or perhaps only a subsistence allowance which continues until other employment is found? If compensation is paid, how should it be paid, in a lump sum or doled out over time? Should a part of any compensation be given in the form of (re)training vouchers or mobility inducements? Finally, if compensation is paid, who should receive it? We know that the farm labor force is relatively young and contains a high proportion of those who harvest crops for only a few years. Can all those to be compensated be identified and located? Should payments be limited to those with two or more years of harvest work? What inequities would any such previous work requirement impose?

If compensation were paid, a financing question would remain. If the links between innovation, benefit, and displacement were made explicit, a tax proportional to the adjustment costs imposed by machine adoption could be levied. Alternatively, compensation payments could be financed from a tax on the agricultural crop itself or even from general revenues, if the tax incidence were inequitable or if increased agricultural efficiency was viewed as an overriding social objective. Any compensation scheme must deal with the work disincentives which may accompany payments of those displaced.

Social impact statements produce another set of implementation issues. If an agency were created to evaluate potential adjustment costs arising from proposed research, who should staff it—researchers, farmworkers, or others? Will such an agency act to facilitate or impede needed research? Given the probabilistic nature of research, what margin of error should it allow? Since research normally takes time, how can the agency evaluate future adjustment costs, which depend largely on prevailing labor market conditions, e.g., how could it evaluate employment opportunities with precision ten years hence? If research were predicted to be labor-displacing, what actions should be taken, e.g., should the research be slowed or halted, should compensatory programs be planned, or should those facing displacement merely be informed?

The farm labor force contains some of the least-skilled and least-adaptable members of society. Given the high benefits thought to accrue to investments in agricultural research, the cost of assisting displaced farmers and farmworkers is relatively low. Rather than designing complex compensation schema or creating monitoring agencies, society could ameliorate conditions for those displaced and those likely to be displaced by (*a*) providing minimum incomes for anyone unable to find work, i.e., strengthening the current welfare system by eliminating its arbitrary gaps in coverage and (*b*) implementing rural manpower policies which are effective in (re)training and relocating displaced workers. Although relatively few people remain to be affected by mechanization and displacement, agriculture could pioneer in devising policies to mitigate the human costs of adjustment to change. Societal investments in agricultural research have returned high dividends; social investments in rural people also promise rewards.

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World Food Sufficiency and Meat Consumption

Peter Svedberg

One of the resolutions adopted at the World Food Conference in Rome urged the rich countries to adhere to simpler and less "calorie-wasting" food-consumption habits. The argument was that in this way large quantities of grain would be released for the benefit of starving people in the Third World. Another main concern at the conference was that a worldwide crop failure in 1974/75 threatened to leave the underdeveloped countries without the imported grain needed to prevent major famines, and a plea was directed to the rich countries to provide large quantities of food aid. This request seems to have been made, however, without due consideration being given to how food consumption in the rich countries would influence the effectiveness of short-term food aid in the prevailing situation.

The objective of this paper is to show that the link between food consumption in the rich countries and the food problem of the poor countries was considered in an erroneous time perspective. Simpler food-consumption habits in rich countries would do very little, if anything, to relieve the long-run food shortage in the poor countries, although a temporary (enforced) cutback of food consumption in the rich countries may under certain circumstances be warranted to solve the short-run problem, i.e., to avert famines in the Third World in years of global crop failures.

The Short-Run Problem

During the seventies, worldwide crop failures have occurred several times (table 1). In 1972/73, the 1.8% below-trend production was mitigated through a substantial reduction of world grain stocks, but there were still sharp price increases. In mid-1974/75, the situations seemed even worse: stocks were the lowest since World War II and production estimates were even further below trend. The food situation seemed especially severe on the Indian subcontinent and in the Sahel. This was the background against which the call for 8 million metric tons (mmt) of grain for food aid was made.

Table 1. World Production, Consumption, and Stocks of Grains; Percentage of Long-Run Production Trend, 1970/71–1977/78

Crop Year	Production	Consumption	Stocks[a]
1970/71	98.5	100.4	14.8
1971/72	103.9	102.8	11.9
1972/73	98.2	101.6	12.7
1973/74	102.6	103.6	9.0
1974/75	96.7	96.6	7.8
1975/76	96.0	95.1	7.7
1976/77	100.0	98.3	8.3
1977/78	97.2	95.4	9.7

Sources: FAO statistical publications; details available from the author on request.

Note: Consumption includes production plus change of stocks; the long-range production trend is 1945/46–1977/78 exponential trend.

[a] Stocks at the opening of crop year.

The conference secretariat estimated that 1 million metric ton of grain would be sufficient to feed 5 million completely destitute persons for a year. Even if waste and corruption are ignored, this type of simple mechanical calculation overestimates the effectiveness of short-run food, because it neglects to account for the effect of increased food aid on world market prices for grains. Prices in the world market are unaffected only if the grain for food aid (*a*) is taken from stocks which would otherwise not have been reduced and (*b*) that the reduction is not very large in relation to the stocks remaining; if it is, demand for stocks would induce price increases. These conditions did not apply in 1974/75.

In the 1960s, production shortfalls were compensated for by adjustments of stocks, which at that time stood at a comfortable 15% or more of annual world consumption. Even at the outset of 1972/73, stocks were abundant. At the opening of the crop year 1974/75, however, they were only about half the average of the preceding decade (table 1), and the countries in possession of these stocks declared emphatically that the remaining stocks were not to be further depleted, signifying that short-run supply is close to being perfectly inelastic. In such a situation, purchases of food grains for aid purposes would have had to compete with commercial demand on the world market and grain prices would have risen. For the net-importing countries, including almost all less developed countries (LDCs),

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higher prices on the world market would have meant a cutdown in commercial imports.

Assuming—for the moment—(*a*) that there is an integrated global market for grains, and (*b*) that different kinds of cereals are perfect substitutes, the problem can be analyzed with the help of figure 1. Demand for grains by the (net-importing) poor countries is depicted by the schedule D_p and that of the rich countries by D_r. To indicate present reality, D_r is assumed to be a little larger than D_p (at P). Total world demand for grains is the sum of D_r and D_p, i.e., D_t. Short-run supply (S_s) is assumed to be completely inelastic. The equilibrium price will then be P. We further assume that there is a reserve of grains ($R - S_s$).

Now suppose that global production is below trend in a particular year and that a famine threatens the poor countries. The rich countries approve the supplying of food (grain) aid to the poor countries, implying that world demand for grains increases by an equal amount (assuming no substitution for commercial purchases of food on either the individual or the national level); poor country demand shifts to, say, D'_p. If the aid is provided through a (small) reduction of reserves, price is not affected ($Q'_t - Q_t = Q'_p - Q_p$). If, on the other hand, aid is made available through purchases on the world market, the price will rise to P' and consumption in the poor countries is cut down from Q'_p to Q''_p (through reduced imports); their net availability of grains has increased from Q_p to Q''_p which is less than the initial aid received. Consumption in the rich countries is reduced by $Q_r - Q'_r$.

In figure 1, a relatively larger share of the necessary adjustment is undertaken by the poor countries as demand in the poor countries is assumed to be more elastic than in the rich countries. How realistic is this presumption? First, relaxing assumption (*a*) above, it should be noted that few governments abstain from interference in food markets. In the rich group, the European countries have variable import levies on most grain products, signifying that domestic demand here is very insensitive to world-market price changes. In the Eastern European countries and in Japan, domestic supply is kept stable through government ad hoc interference in grain trade. Only in the United States, and possibly Canada and Australia, is domestic demand elastic—especially for feed-grain—with respect to world-market price changes (U.S. total feed grain use in 1974/75 was 24% lower than the year before; Soth 1978, p. 7). Because the United States accounts for only one-fourth of the rich countries' grain consumption, aggregate demand elasticity is probably rather low for these countries. However, governments in poor countries also intervene in grain trade and subsidize food in times of shortages, but their possibilities to keep domestic supply constant are limited by their chronic shortage of foreign exchange. Therefore, import demand is probably more sensitive to world market prices in the poor than in the rich countries. If so, the result derived in figure 1 holds; i.e., in situations like the one in 1973–75, the adjustment burden necessary to make room for food aid is borne largely by the poor countries. However, the relative size of the aggregate demand elasticities for poor and rich countries is an unsettled empirical matter which warrants some caution in interpreting this result.

The second major simplifying assumption was that different cereals are perfect substitutes. If we recognize that grain imports by poor countries are made up largely of food grains which are less demand elastic and more completely protected by

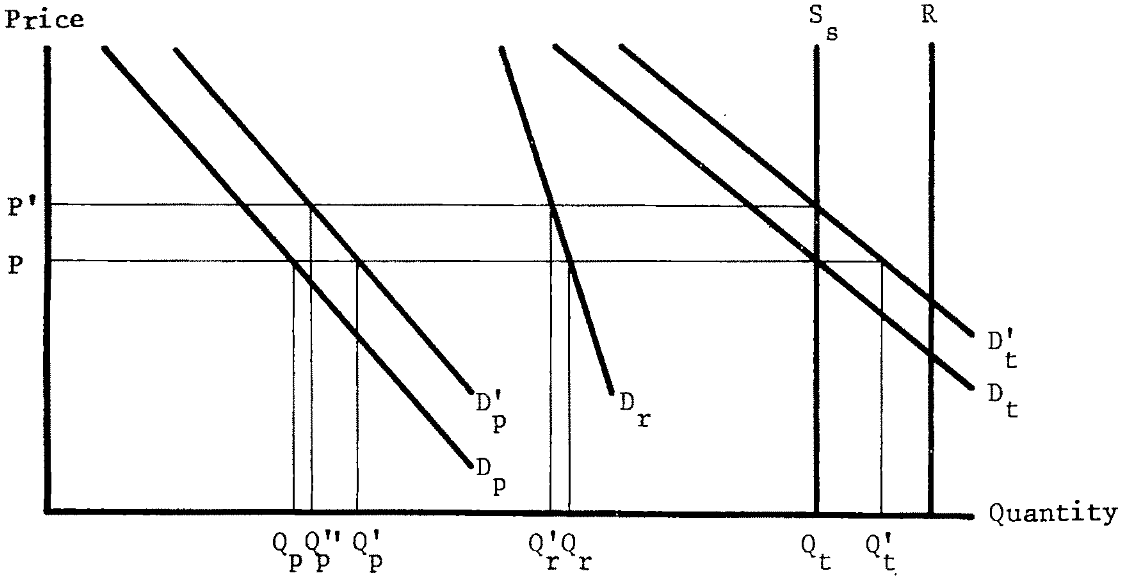

Figure 1.

variable levies than are feed grains in the European countries, then our relaxation of this assumption does not seem to weaken the result; rather, the reverse seems to occur.

The analysis hitherto has focused on the impact of short-run food aid on the distribution of food between rich and poor countries. Food aid, however, is usually not intended for poor countries per se, but for the most seriously affected sections of their populations. In order to clarify whether or not the above discussed effect of food aid on food prices has any relevance for the possibility of reaching this primary aim, it is convenient to start by discussing two hypothetical extreme situations.

Ignoring the price effect may be legitimate in a situation where (*a*) the starving groups are small, easily identifiable, and separable; (*b*) they depend on food aid for their entire subsistence; and (*c*) the rest of the population has income and nutrition standards above the existence minimum. Under these circumstances, the higher food prices triggered by food aid will hit only other groups which (by assumption) do not have to cut down food intake to a starvation level. The other extreme situation is when (*a*) all individuals in the poor countries have the same low incomes and the same nutrition standards, and (*b*) the food aid is evenly distributed among all individuals in these countries. Then the relative net increase in the availability of food will be the same for any individual in the poor countries.

In a "normal" year of low world food supplies, the actual situation is somewhere in between these two extremes. The food aid is typically given to selected countries, and it is channeled to certain groups within those countries. These groups, of course, will have their consumption standards improved, even though they may feel the higher food prices to the extent that they supplement the food aid received through commercial purchases. Other starving groups, however, within both the aid-receiving countries and other poor countries will be exposed to the higher prices without having received any food aid. These groups will have to cut down consumption by roughly the same proportion as real food price increases because they already are spending all their income on food. The main effect of food aid thus seems to be to redistribute food within and among the poor countries.

The important question is whether the reshuffle of food through food aid works in an egalitarian direction, i.e., in favor of the most seriously affected groups. This is partly a question of which countries would be most likely to receive food aid. In the event of a major crop failure in the world, one that included even the densely populated countries with chronic food problems, food aid is apt to be rather meagre (as it was in 1973 [OECD 1974, table V-2]), making the decision of which poor countries to assist difficult for the donors. Humanitarian considerations will favor the most seriously afflicted countries; political and economic considerations will favor the ones most important to the major aid donors. If political and economic considerations predominate, as is often the case, food aid may very well worsen the situation of the most seriously afflicted countries.

There is also the question of whether food aid is (generally) directed towards the most needy sections of the populations within the countries receiving the food aid. The risk of widespread famine in a poor country is larger, of course, the more uneven the internal income distribution, and the less the government cares about the poorest section of the community, *ceteris paribus*. The greatest exigencies are, therefore, apt to be found in countries with little government involvement in redistributing food to the most needy. In such countries, food aid is likely to be channeled to politically powerful groups rather than to the most distressed groups whose political leverage is usually far too weak to influence distribution in their favor.

The important conclusion to be drawn from the above analysis is that food aid purchases of large quantities of grain in the world market for the LDCs in times of worldwide food shortages may not in itself increase correspondingly the total supply of food in these countries. The first policy implication following this conclusion is that it is very important that the aid effectively reaches the most seriously affected sections of the population of the Third World. If not, the aid will cause additional hardship to these groups, through higher prices. The second implication is that in order to make short-run food aid an efficient way of increasing the net availability of food in LDCs, the effect on world market food prices has to be eliminated. In a situation where there are no reserves to deplete, this can only be achieved through a temporary cutdown on grain (meat) consumption in the rich countries. The third policy implication is that in order to eliminate, in years to come, the risk of major famines in the Third World, either of two policies has to be followed. One is to build up government-supported grain stocks on the national or international level. The other possible solution is an international agreement upon free trade in grains. If the price mechanism is given free rein, the experience from the United States in 1974/75 suggests that demand for feed grains is elastic so that meat consumption is automatically reduced and more grains become available for export to the LDCs in short grain years. Feedstock can thus fulfill rather the same function as regular grain stocks (Soth 1978, p. 7).

The Long-Run Problem

It has been argued that simpler and less "calorie-wasting" food habits in the rich countries would be a solution to the LDCs' long-run (a few decades) food problem. The proposers note that nearly one-third of world grain production is used for animal feed, providing meat mainly for consumption in the rich countries (FAO 1974a, table 17). Moreover, "the increase in per capita cereal consumption in the OECD countries and the USSR during the past eight years almost equals total cereal consumption per capita in developing countries in 1973" (OECD 1974, p. 23).

Statistics of the loss of calories involved in feeding grains to animals and of the number of people that could be fed by the grains "freed" if people in the rich countries ate less meat and more bread provide clear evidence of the unequal distribution of world consumption; but they also show, paradoxically enough, what small efforts are needed to eradicate the most pressing misery in the Third World. In this respect, the statistics are indeed well worth considering. But, do they really show that the long-run food problem of the LDCs would be alleviated if consumers in the rich countries adhered to simpler food habits? Suggestions to that effect seem to be based on a conception of given world "food resources" existing independently of supply and demand conditions. The notion of a world food "cupboard," from which more taken out by one individual means less for the rest, is not only misconceived, but also helps conceal the real problem: the political and economic mismanagement taking place in the food-deficit countries—mismanagement which may depend partially on the overall interrelationship with the rich countries but hardly on the food consumption patterns abroad.

In economic terms, the cupboard theory (in its most naive form) rests on the implicit assumption that the supply of grains is given, i.e., completely inelastic. This assumption was used above for the analysis of the short-run problem, but to assume a totally inelastic long-run world supply of grains is unrealistic. Without going into the empirical question of the exact size of the supply elasticity, we shall discuss how the LDCs' long-run food situation would be affected by a substantial change towards simpler food patterns in the rich countries with the help of a simple model (figure 2). As before, we assume a perfectly integrated global market for grains and D_p and D_r depict demand in the poor and rich countries, respectively; S_1 denotes supply. D_t is total world demand and P is the initial equilibrium price.

Assume now that consumption of meat in the rich countries is reduced permanently, causing a drop in demand for cereals; D_r shifts to D'_r. Since in the very short run, supply is assumed given, price falls to P'. The poor countries increase their consumption from Q_p to Q'_p. So far, the analysis runs parallel to the prior analysis of the short-run problem. However, the lower price means that profitability drops and resources begin to move out of grain production. Supply will be reduced, prices will rise, and, finally, a new equilibrium will be established at a lower world production (Q'_t) and price (P''). The poor countries have gained an increase in real income (i.e., an improvement in their terms of trade) equal to $m(P - P'')\ (Q_p + Q''_p) \cdot 0.5$, where m is their import share in grain consumption. They also increase consumption of grains from Q_p to Q''_p. Evidently, the less elastic the world supply, the larger the gain for the LDCs from a given reduction of demand for grains in the rich countries.

One does not have to go into a detailed empirical analysis to show the plausibility that even a drastic reduction of grain consumption in the rich countries would not significantly alter world market prices of grains and thus improve the poor countries' terms

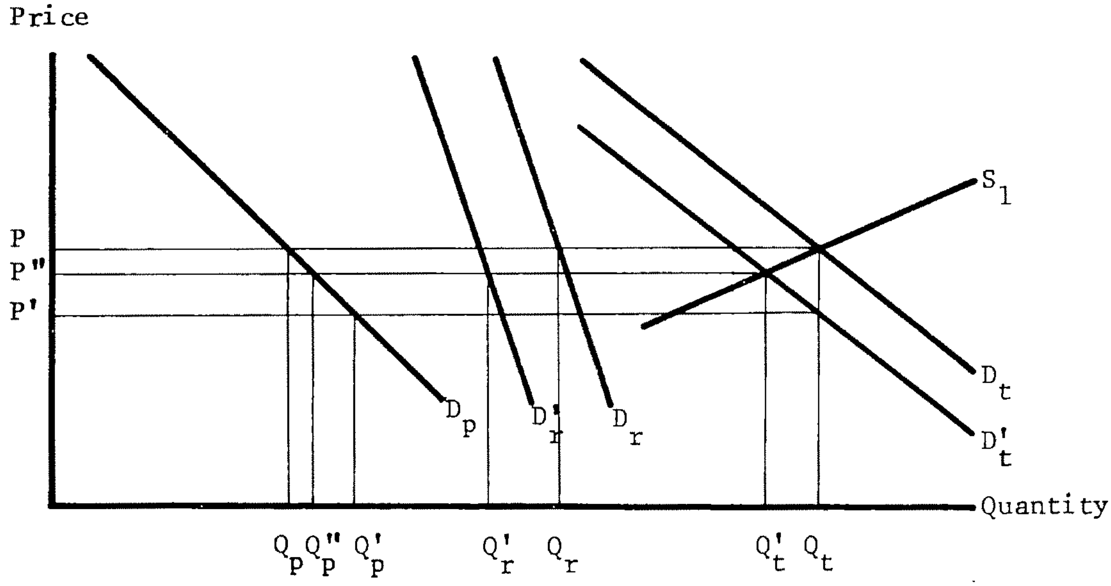

Figure 2.

of trade. A reduction corresponding to one-third of the rich countries' present grain consumption (about 200 million metric tons) would only lower the average world market price by some 10% when one assumes the (free-trade) demand and supply elasticities to be of the size usually suggested in the literature. (Tweeten and Quance [p. 369] estimate the long-run supply elasticity of crops in the United States at 1.5.) Given the size of the poor countries' imports (about 50 mmt after allowing for the estimated increase following lower prices), a price decrease of this size—from an average grain price of $140 per ton—entails a terms-of-trade improvement to the poor countries worth less than $1 billion, or a little above 0.1% of their gross domestic product (GDP). Moreover, as pointed out to me (in personal correspondence) by D. Gale Johnson, "since developing countries are substantial *net exporters* of agricultural products, it is highly likely that a decline in grain prices would result in a decline in the prices of other agricultural products, primarily through shifts in production. Thus, the overall improvement in LDC terms of trade might well be less than [suggested by the above] estimate."

To summarize, altered food habits in the rich countries seem to be an inefficient, if not impossible, means of solving the long-run food problem in the Third World. This is because (*a*) the decrease in food prices on the world market tends to be small because production is also going to fall, (*b*) the effect is not aimed directly at those starving, i.e., the lower prices will not benefit only the starving but also the rich in all countries, and (*c*) there is no guarantee that the governments in the starvation-stricken countries would use the additional incomes to improve the lot of the people suffering from extreme hunger.

This is not the occasion to go into the question of how to solve the long-run food problem in underdeveloped countries, but any attack on starvation must focus directly on those starving. It has been estimated that the additional food needed to provide sufficient nutrition for the approximately one-half billion people lacking it corresponds to about 2%–4% of the present world production of grains. An increase in world production of this size is, of course, easily implemented; the problem is one of securing purchasing power for the starving people and/or the means for they themselves to produce more food (Taylor 1975).

The Very Long-Run Problem

Considering the world's capability to feed its population in the very long run, the worst that can happen is that the population in the LDCs continues to grow at precedented rates while, at the same time, no improvements in living standards take place. (In the long run this is one reason why population growth tends to slow down.) If this happens, and if no revolutionary technological breakthrough in agriculture occurs, the long-run supply could become inelastic. The question is how long supply could keep pace with a rapidly growing population in the LDCs before this happens. If this time span is short, a substantial reduction of grain consumption in the developed countries (DCs) could be a means of improving or preserving food standards in the LDCs. If the time span is long, the DCs' share of grain consumption will probably be so small that even a major cut in their consumption would only marginally improve the situation in the LDCs.

There are two major components explaining long-run demand for cereals: population and real income. In 1952–72, population in the LDCs grew by 2.4% per year, and by 1.3% in the DCs (FAO 1974b, p. 94). In roughly the same period, growth of GDP in the two sets of countries was about the same (UNCTAD 1972, table 6.2); and because aggregate income elasticities for grains have been fairly equal (FAO 1974b, pp. 111–16), increases in demand due to affluence have been about the same. On the whole, therefore, the DCs have decreased their share of world grain consumption from 64% to 51% 1934–70. According to FAO (1974b, p. 120) projections, the share will have declined to 44% by 1990.

Projections extending for more than a decade are, of course, always highly risky undertakings, but there are at least two reasons to believe that the DCs' share will continue to decline after 1990 if the LDCs population continues to grow rapidly. First, the increase of per capita demand in the DCs will most certainly slow down and, eventually, come to a halt. The projected per capita increase will be 0.7% a year up to 1990 (FAO 1974b), and by that time, per capita consumption in all DCs will have reached the present level in the United States (about 750 kilos per year). In the United States, the per capita consumption has been at this level for decades (Johnson 1975a, pp. 41–42), and there is no reason to believe that the saturation level should be higher in other DCs. Second, population growth is likely to decrease in the DCs. The United Nations' middle-alternative prognosis is a 0.9% increase per year up to 1990, but it seems that this is an overestimate; the increase has already been below this mark in the 1970s and the rates seem to be declining still further (Mauldin, p. 396). If one is to judge from data from Sweden, Germany, and some Eastern European countries, population increases in the DCs will either cease completely or will be very small, especially when compared to present-day rates in the LDCs.

As an illustration, suppose that the rich countries' consumption is cut in half at the time when their share of world grain consumption is 25% and the grains freed are transferred to the poor countries, in one way or the other. These countries' consumption can then be increased by some 17% and it would only take about seven years before the increase is (literally) eaten up through further population increases (of today's size). After that there is no way in which the poor countries' consumption can increase (since supply is assumed inelastic) and their population will stagnate due to increased rates of mortality.

Finally, the important empirical question: can world cereal production increase by the 200%–300% implied in the above illustration before the production ceiling is hit, i.e., when the supply turns very inelastic? In this paper we cannot provide new evidence on this point. A thorough review of the literature, however, suggests that the present effective production level can be increased many times over, even with present-day technology, through productivity increases resulting from institutional reform, by the use of additional physical inputs and new varieties of seeds, through bringing more land under cultivation, and by reducing the spoilage and waste that occur in all stages of production between harvesting and final consumption. (See in particular, FAO 1974a, OECD 1976, Chapman et al., Revelle, Leontief, Linnemann, and several studies in Clark and Cole.) There are, of course, also studies which take a pessimistic view of the potentialities (de Vries, several contributors to Aziz, and IFPRI), but in our opinion, these latter focus more on the question of what could be achieved politically, rather than what is feasible economically/technically.

Conclusion

The above analysis leads us to conclude that if ever the food situation of the world's poor hinges upon the availability of additional resources for the production of food, a major redistribution of the quantities consumed in DCs will do very little to relieve the food situation in LDCs. This is because, at that time, the DCs' share of world food consumption probably will be too small to free the quantities needed to aid the poor. A reduction of food consumption in the rich countries can only in the very short run, and under rather special circumstances, be warranted as a means of relieving food insufficiency in the poor countries.

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Short-Run Predictive Models for Retail Meat Sales

B. W. Marion and F. E. Walker

Demand analysis has long been a central concern of agricultural economists. Typically, price-quantity relationships have been examined using time-series data for various commodities for broad geographic areas. The results have proven useful for many types of decisions (Brandow, Breimyer), but they are of limited value at those stages in the food system where specific products are traded (round steak or ground beef rather than U.S. Choice beef carcasses), where the sales of an individual firm must be estimated rather than the sales of all firms in a market or region, and in those situations where firms operate in a short-term decision environment with short-run variations in demand that are not accounted for in traditional demand models. All of these conditions hold for individual retail food firms.

Short-run variations in the demand faced by food retailers are particularly troublesome in accurately anticipating sales. Retailers operate in local markets with considerable interdependence with other retail food firms. The behavior of competitors is difficult to anticipate and thus may alter the demand faced by a particular firm from week to week. In addition, industry personnel contend that other factors also influence short-run demand and/or sales. These include weekly advertised specials, merchandising variables such as the closeness of trim or the size and location of displays, and closeness to payday.

Variations in the farm and wholesale prices of commodities such as broilers, beef, and pork (as well as many other agricultural commodities) are often substantial from week to week or even within a single week. While variations in supply account for some of the variation in prices, industry participants have also contended that variations in demand—largely due to supermarket specialling activity—are also important causes of short-run price instability.

The research summarized in this paper examines the weekly price-quantity relationships for specific meat products at the retail store level. It is thus concerned with short-run demand relationships that have a direct bearing on the pricing, ordering, and inventory control tasks of retail food firms, and that also influence the short-run derived demand schedules faced by firms at other stages in the poultry and meat subsectors.

Relatively few published studies have examined very short-run disaggregated demand relationships at the warehouse, retail, or consumer level. Johnson and Long were reasonably successful in developing predictive models for the weekly movement of selected produce items at the wholesale distributor level. Purcell and Raunikar approached the problem by collecting data on meat, poultry, and fish purchases from a consumer panel. Using the changes in the prices of various products as independent variables, their models explained a relatively small proportion of the observed variation (less than 40% for the most part) in the weekly purchases of beef and veal, pork, poultry, meat mixtures, and fish. Although Purcell and Raunikar examined weekly price-quantity relationships, they did so on product groups that were too broad to capture adequately the influence of retail-pricing and specialling behavior.

Funk, Meilke, and Huff examined the factors affecting the weekly sales of carcass beef and individual beef cuts for two chains in Toronto. The study used data on the total shipments of beef carcasses, quarters, and primals to all Toronto stores of each chain. Analysis of individual store demand was not attempted. The sales of meat products other than beef were also not examined. The model employed by Funk, Meilke, and Huff was similar to the one used in the study reported here except that no income variable was included in their model. The chain's beef prices, the prices of other meat products, and the advertising devoted to beef by the chain were the most important factors affecting weekly beef sales in the Canadian study.

The present study examines the sales of five meat products in the meat departments of two Ohio supermarkets over a fifty-two week period. While still lacking in precision, the models lend encouragement to the possibilities of developing short-run predictive models that allow retailers to anticipate sales more accurately and that identify for producers, processors, and consumers some of the factors causing variations in short-run demand.

Problems in Developing Retail Meat Predictive Models

Conceptually, predictive sales models pose few problems. However, the characteristics of fresh

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meat distribution present practical problems in model formulation. While meat is priced, advertised, and sold to consumers by retail cuts (e.g., round steak, English roast), most fresh meat products are distributed to retail stores as wholesale primal cuts (e.g., beef round, beef chuck, pork loin) or as sub-primals. Very few retail firms have the capability of recording the pounds sold of the various retail cuts derived from the primal cuts. Thus, most explanatory efforts are forced to relate the pounds sold of wholesale primal (or sub-primal) cuts to the pricing and advertising of the derived retail cuts.

Unfortunately, the "mix" of retail cuts sold is seldom in perfect harmony with the pounds of each retail cut derived from the wholesale cut. A particular store, for example, may find that of the retail cuts from a beef loin, sirloin steak sells much better than porterhouse steak. This type of imbalance is overcome by adjusting store level factors to influence sales. The size and location of displays, point-of-sale material, the use of different cutting methods (e.g., bone-in vs. boneless), and the closeness of trim are frequently varied. Since store level adjustments vary from week to week, depending on what is advertised and what is in long supply, problems arise in measuring short-run demand relationships.

The cooperating chain in this study was selected because less store level adjustment of factors affecting meat sales occurs than in most chains. Display space allocations by cut are carefully controlled by chain headquarters. The firm also follows a "specialling" strategy of advertising many items at moderate price reductions each week, instead of a few items with large price reductions. This results in less distortion of the mix of products sold, and hence, calls for fewer adjustments at store level to sell all the retail cuts from each wholesale cut. (When a few items with large price reductions are advertised, a store may sell many times its normal volume of certain retail cuts but have difficulty moving the remaining cuts from the wholesale cut.) While these factors resulted in fewer store level adjustments in the operating chain, they were not eliminated altogether and were a sales-influencing factor not included in the models. Minimizing store level influences by working with a single chain limits the generalization to other food chains; however, it does not invalidate the results of this analysis.

Predictive Models

Ten predictive models are developed (one for each of five product classes for each of two stores). These five products constituted 41% and 44% of the total pounds of meat sold in stores A and B, respectively. They represent a considerably higher percentage of the total fresh meat sold, for which accurate forecasting and inventory control is particularly important. The general model is

$$PdsA = f\,(PrA,\ PrO_i,\ Gr,\ Temp,\ Season,\ Payday,\ Adv),$$

where $PdsA$ is pounds of product A; PrA, composite price of retail cuts from product A (¢/lb.); PrO_i, composite price (¢/lb.) of competing retail cuts from product O_i (i is set of other products); Gr, chronological number of each week (1–52) used to measure growth trend that is not seasonal in nature; *Temp*, average weekly temperature (degrees); *Season*, dummy variables, one for each season of the year (December-February, March-May, June-August, September-November—the latter is the base period); *Payday*, nearness of payday (dummy variables designating each week of the month, with week 4 as the base week and weeks 1 and 3, payday weeks); and *Adv*, nine variables (one for each meat category) that measure the number of retail cuts advertised in bold print each week (the nine categories are the five wholesale cuts studied plus beef rib, ground beef, bacon and weiners, and smoked meats).

Prices of competing stores were not included in the model because predictive models, to be operational, should not require data that are not readily available. Without corporate espionage, retailers do not know their competitors' prices a week in advance. The temperature and the season variables are alternative measures used as a proxy for seasonal shifts in consumer demand for these products. Because they are highly correlated, it is expected that only one of these measures will appear in any model. In order to examine the hypothesis of changing quantity-price relationships for different weeks of the month, a joint variable, *Payday* times *PrA*, was introduced.

The parameters of this model were estimated using thirty-two weekly observations. Twenty of the fifty-two observations were deleted because of holidays (twelve weeks), missing data (seven weeks), or because one of the items was sold out (one week). All variables were measured in natural numbers and fit to a linear relationship.

Results

While the general model above was the initial one used for each of the ten cases, the final estimated equation for each contained only a subset of all variables. The variables to remain were selected on the basis of adjusted R^2, significance of the regression coefficients, and stability of regression coefficients of remaining variables upon removal of one or more insignificant independent variables. This method of variable selection distorts tests of significance (Wallace). However, the benefit gained through identifying the factors that affect sales is reason for using such a method. Furthermore, an objective evaluation and use of the results is paramount (Freund and Debertin).

Statistical estimates (table 1) indicate reasonably similar results for each of the stores for the same product. With one exception, the variables (or sets of dummy variables) included had *t*-ratios larger than 2.0 (*F*-ratios larger than 3.0 for a set of dummy variables). These ratios carry the caveat of distorted test statistics associated with the variable selection procedure. Product price, *PrA*, was forced to be included in the model, whether significant or not. This affected only two cases, beef chuck and pork loin, in store B.

For each case, the coefficients of the own-price variables were negative and twelve of the fifteen cross-price coefficients had the expected positive sign. Only newspaper advertising, *Adv*, showed no relationship with product sales in any of the ten models. In addition, its presence tended to produce highly unstable results. This lack of importance of *Adv* may be due to the relatively small week-to-week changes that occurred in the ads of the cooperating chain. Many of the same items appeared week after week with only slight changes in price. The conclusion is that either advertising had no influence in this situation or the method of measurement of advertising did not effectively discriminate between changes in emphasis within the ads.

As expected, either temperature or season was included in each model, except for the case of beef loin in store A. For this case, both variables were significant, and removal of either one greatly affected the estimates of the coefficients of the other remaining variables. Sales of all products, except beef round, were highest during the warm summer and autumn quarters.

The importance of nearness of payday was not entirely anticipated. The variable, *Payday*, affected sales in eight of the ten cases: four through the intercept only, two through slopes changes (*PrA* times *Payday*) only, and two through both slope and intercept changes. The *Payday* variable reflects the amount of cash available to store customers from week to week. Viewed in this way, it could affect a consumer demand curve, causing shifts in the sales (different intercepts), as well as changes in the price-quantity relationship (different slopes). The influence of paydays on the responsiveness of sales to price varied widely, however, with no general pattern across stores or products.

With the exception of two cases (beef chuck and pork loin in store B), the estimated price elasticities in table 2 are considerably larger in absolute value than those estimated by Purcell and Raunikar, and by Breimyer. The elasticities estimated in this study are very short-run, in that the data measure changes in sales from week to week. Consequently, for two reasons they are not expected to be comparable to elasticities based upon a three-month or one-year unit of observation. First, where the length of sales adjustment period is very short, the changes in purchases in response to price changes will likely be used more for changes in stocks (to be consumed in later time periods) and less for changes in consumption during the current time period (see Pasour and Schrimper). Second, the demand relationships in this study are those faced by a single oligopolistic firm as compared to the demand for an entire market. Because of the interdependence of supermarkets, some shifting of customers from one store to another continually takes place.

There appears to be some relationship between the "quality" of the product and its price elasticity. Beef loin and beef round are more price elastic in both stores than beef chuck, pork loin, and fryers. This is consistent with the findings of Funk, Meilke, and Huff.

The two stores had similar elasticities for fryers, fairly similar elasticities for beef round and beef loin, but quite different elasticities for beef chuck and pork loin. Store B customers tended to be less responsive to price changes than store A customers.

Mean prices for the five products during different weeks indicate a tendency for the cooperating chain to charge higher prices during week three. The mean price for all three beef products and for fryers was highest during week three; for pork loin, week three had the second highest price. Week three also had the highest elasticity coefficients for five of the ten models. Given the tendency to charge highest prices during the most price elastic week, it is not surprising that the mean quantity sold of beef products and of fryers was lowest during week three. For pork loin, however, week three was the highest volume week for the two stores.

No similar pattern is apparent for the weeks when prices were lowest. On average, prices were lowest for beef round and fryers during week one, for beef loin and pork loin during week two, and for beef chuck during week four.

There was a strong tendency for the week with the highest average volume for each product/store model also to be the week with the lowest price elasticity of demand (nine cases out of ten), and conversely, for the low average volume week also to be the week with the highest price elasticity coefficients (also nine out of ten cases). This seems to reflect irrational pricing procedures. However, the most profitable specialling strategy may not be what it appears on the surface. Not only must the price elasticity and the cross elasticity of demand be considered in selecting products to special, but also the power of specialled products to attract customers.[1]

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[1] Although economists are accustomed to evaluating the incentive to raise or lower prices on the basis of price elasticities, this is not appropriate in the case of a retail firm. Even when ignoring the customer-attracting dimension of specials, a retailer must consider the "margin elasticity" of products, not the price elasticity. For

Table 1. Equations for Ten Product-Store Models

Independent Variables	Beef Round		Beef Chuck		Beef Loin		Pork Loin		Fryers	
	Store A	Store B	Store A	Store B	Store A	Store B	Store A	Store B	Store A	Store B
Prices:										
Beef round	−84.01 (9.62)	−112.55 (12.60)	43.52 (7.92)	23.88 (11.95)			36.11 (14.17)	41.42 (17.31)		
Beef chuck			−73.04 (18.09)	−13.89 (26.75)			68.47 (28.15)	134.05 (34.00)		
Beef rib							−79.91 (24.25)	−53.53 (27.59)		
Beef loin			−11.97 (6.80)	20.52 (8.48)	−60.50 (9.70)	−139.25 (17.75)			29.06 (5.59)	37.39 (7.41)
Pork loin		54.33 (13.06)			22.87 (9.71)	109.83 (25.94)	−51.08 (13.65)	−14.61 (17.73)		
Fryers									−90.12 (6.68)	−129.84 (15.45)
Growth	8.66 (2.62)			−3.67 (3.90)		14.98 (6.01)	−11.70 (4.75)			
Temperature	−16.10 (2.66)	−16.09 (3.21)		7.56 (3.65)	−8.89 (3.04)				8.10 (1.68)	9.85 (2.22)
Season dummies:										
Winter					−341. (95.)	−1036. (190.)	−428. (149.)	−582. (194.)		
Spring					−208. (67.)	−238. (176.)	−110. (121.)	−273. (142.)		
Summer					3. (91.)	101. (188.)	−219. (127.)	22. (133.)		
Payday intercept dummies:										
Week 1	285. (100.)		88. (96.)		−2691. (1173.)			−220. (144.)	264. (81.)	2721. (855.)
Week 2	172. (82.)		−172. (84.)		−1449. (954.)			−299. (120.)	−7. (68.)	−1113. (806.)
Week 3	134. (82.)		55. (87.)		−3039. (1154.)			129. (124.)	4. (68.)	3673. (929.)

Payday slope dummies:										
Week 1				−0.21	31.18		−3.25			−67.97
				(2.37)	(14.58)		(1.70)			(23.93)
Week 2				−9.01	17.27		−4.27			30.10
				(1.96)	(12.12)		(1.44)			(22.42)
Week 3				−0.70	37.40		−0.13			−102.50
				(1.99)	(14.24)		(1.47)			(25.49)
Intercept	8325.	7383.	2644.	−1015.	4657.	5609.	4998.	−3164.	1511.	2611.
Adjusted R^2	.813	.733	.620	.637	.670	.705	.608	.503	.890	.929
Mean of dependent variable	1740.	1858.	1262.	1836.	675.	1775.	1489.	1477.	1044.	1459.
Std. error of est.	175.	249.	178.	199.	123.	327.	183.	238.	143.	189.

Note: The standard error of the corresponding coefficients are in parentheses under each coefficient. Those coefficients for which there are no standard errors given are for variables which are part of a set of dummy variables. The coefficient is estimated indirectly. The estimates for each model are based on thirty-two observations.

Table 2. Price Elasticity Coefficients by Product and Store during Different Weeks

	Week 1	Week 2	Week 3	Week 4
Elasticities of products with significantly different slopes during different weeks				
Beef chuck (store B)				
Mean price (¢)	49.01	49.16	50.00	48.73
Mean quantity (lb.)	1950.	1515.	1912.	1964.
Elasticity	−0.35	−0.74	−0.38	−0.34
Beef loin (store A)				
Mean price (¢)	79.78	78.12	81.40	79.13
Mean quantity (lb.)	514.	724.	631.	763.
Elasticity	−4.55	−4.66	−2.98	−6.28
Pork loin (store A)				
Mean price (¢)	65.58	64.36	64.80	64.68
Mean quantity (lb.)	1329.	1330.	1574.	1588.
Elasticity	−2.68	−2.68	−2.11	−2.08
Fryers (store B)				
Mean price (¢)	35.26	35.48	36.32	36.04
Mean quantity (lb.)	1833.	1435.	1321.	1407.
Elasticity	−3.80	−2.47	−6.39	−3.32
Elasticities of products with slopes which were not significantly different during different weeks				
Beef round (store A)				
Mean price (¢)	72.34	73.45	73.69	72.71
Mean quantity (lb.)	1113.	906.	848.	797.
Elasticity	−5.46	−6.81	−7.30	−7.66
Beef round (store B)				
Mean price (¢)	72.34	73.45	73.69	72.71
Mean quantity (lb.)	1944.	1819.	1792.	1902.
Elasticity	−4.19	−4.54	−4.63	−4.30
Beef chuck (store A)				
Mean price (¢)	49.01	49.16	50.00	48.73
Mean quantity (lb.)	1380.	1453.	1275.	1313.
Elasticity	−2.59	−2.47	−2.86	−2.71
Beef loin (store B)				
Mean price (¢)	79.78	78.12	81.40	79.13
Mean quantity (lb.)	1760.	1991.	1534.	1850.
Elasticity	−6.31	−5.46	−7.39	−5.96
Pork loin (store B)				
Mean price (¢)	65.58	64.36	64.80	64.68
Mean quantity (lb.)	1331.	1270.	1691.	1564.
Elasticity	−0.72	−0.74	−0.56	−0.60
Fryers (store A)				
Mean price (¢)	35.26	35.48	36.32	36.04
Mean quantity (lb.)	1321.	1031.	966.	987.
Elasticity	−2.41	−3.10	−3.39	−3.29

Note: The elasticities are measured at the weekly mean price and quantity for the entire year.

If we assume that the difference in the price sensitivity of product sales during different weeks is largely due to differences in the quantity purchased per customer rather than to the number of customers, then the customer attracting power of specials during different weeks would be assumed to be similar. Further assume that consumers tend to have a limit to the quantity of meat purchased (in pounds or dollars) and that large purchases of a product on special reduce the purchases of nonspecialled meat. Under these assumptions, the profit-maximizing specialling strategy appears to be the reverse of that suggested when only the individual products are considered; i.e., products should be featured during weeks when their price elasticity is lowest.

Conclusions and Implications

This research suggests conclusions germane both to retail food firms and to those interested in the problems of short-run coordination of agricultural subsectors. For food retailers, the research suggests that accurate predictive models for retail meats are

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example, retailers realize a gross margin on sales of about 20% for meat products. A price reduction of 10% results in a 50% decline in gross margin. In order for gross margin dollars to remain constant, sales would have to double, reflecting a price elasticity of approximately −10. There are few products with sufficiently high price elasticities at the retail level to justify specialling if only the sales of the products on special are affected.

feasible if the effect of store level manipulation of factors influencing sales is included and if accurate data are obtainable on product sales. If accurate predictive models can be developed, an important barrier to more scientific and precise planning and decision-making in retail food firms will have been overcome, allowing better service of customer needs, yet lower levels of inventories and associated product loss.

For those interested in subsector coordination, the results suggest that retail specialling practices and the influence of paydays hold the potential for either confounding or improving vertical coordination. In particular, the week of the month was found to have a much more pronounced effect on product sales and price elasticity than anticipated. If the supplies of meat and poultry products are relatively stable from week to week, then volatile short-run demand conditions would be expected to create price instabilities and short-run problems of coordinating supply and demand.

Although our results indicate that average sales and price elasticities vary considerably by week of the month, the limited number of stores studied prevents conclusions concerning the demand relationships that are most typical at the retail store level. A more broad scale research effort on demand for meat products at the retail level holds potential for assisting processors, retailers, and consumers. Periodic inequality of supply or demand create short-run excesses or shortages in supply. Knowledge of weekly price elasticities would allow processors or retailers to deal with these temporary shortage or surplus situations so as to minimize price volatility. For example, if store A reflects "typical" retail demand characteristics, a surplus of beef loin could be marketed with least impact on price by specialling beef loin during week four. Surpluses of beef round, beef chuck, and fryers could be eliminated with the least depressing effect on price during weeks three and four. If supplies were short, beef loin specials during week three, and beef round and fryer specials during week one would have the least disruptive effects on available supplies. Without more information on the substitution and customer attracting effects of different specials during different weeks, we are unable to judge whether retail profit-maximizing behavior will tend to stabilize or increase the variation in the weekly quantity of individual products sold.

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Estimating Components of Demand Elasticities from Cross-Sectional Data

C. S. Thraen, J. W. Hammond, and B. M. Buxton

Purchase of a product or service involves two types of adjustment to changes in demand determinants: (*a*) possible exit from, or entry into, the market, and (*b*) changes in quantities purchased by those already purchasing the good or service (Haidacher). Time-series observations on changes in total consumption reflect both types of adjustment. However, it is impossible to estimate the separate types of adjustment from aggregate time-series data based on per capita consumption. Cross-sectional data, on the other hand, include observations of individual consumers—some of whom are purchasers and others who are not. Although one could estimate quantity adjustment coefficients for various demand determinants by exclusion of those who did not purchase from the sample of cross-sectional observations, it is possible to estimate both the quantity adjustments of consumers actively purchasing and the quantity adjustment due to entry-exit of consumers. This article presents the formal relationship between these two types of adjustment and suggests the usefulness of the Tobit model to provide estimates of these adjustments.

Total Elasticity and Consumer Demand

In a market of N potential consuming households, there will be only n actual households purchasing an aggregate quantity of a product (Q) at any given price. The $N - n$ consuming households are assumed not to purchase any of the product because the market price is above their reservation or threshold price.

The derivation of the total elasticity concept is as follows: let $\bar{q} = \frac{Q}{n}$ be average quantity taken by households actually purchasing some of the product and $q^* = \frac{Q}{N}$ be average quantity purchased by all households in the population; then for $n = N$, $q^* = \bar{q}$ and for $n < N$, $q^* < \bar{q}$. In addition, let $PR = n/N$ be proportion of total households actually purchasing some of the product so that $q^* = \bar{q} \cdot PR$.

Assuming that both the quantity purchased and the proportion of households purchasing depends on price, the total price elasticity of demand can be expressed as

$$(1) \qquad Eq^*p = \left(\frac{\partial q^*}{\partial p}\right)\left(\frac{p}{q^*}\right).$$

Substituting for q^* yields

$$(2) \qquad Eq^*p = \left(\frac{\partial(\bar{q}\,PR)}{\partial p}\right)\left(\frac{p}{\bar{q}\,PR}\right).$$

The first term on the right-hand side of equation (2) may be expressed as

$$(3) \qquad \frac{\partial(\bar{q}\,PR)}{\partial p} = \left(\frac{\partial \bar{q}}{\partial p}\,PR\right) + \left(\frac{\partial PR}{\partial p}\,\bar{q}\right).$$

The elasticity after multiplying each term by $(p/(\bar{q}\,PR))$ is

$$(4) \qquad Eq^*p = \left(\frac{\partial \bar{q}}{\partial p}\,\frac{p}{q}\right) + \left(\frac{\partial PR}{\partial p}\,\frac{p}{PR}\right).$$

The first term on the right-hand side is the elasticity of demand with respect to the product price for those households actually purchasing some of the product. The second term on the right-hand side is the elasticity of the proportion of households purchasing some of the product with respect to the product's price. Thus, corresponding to equation (4), the total elasticity is

$$(5) \qquad Eq^*p = E\bar{q}p + E_{PRp}.$$

Equation (5) illustrates that the total quantity adjustment to price changes includes two parts: (*a*) estimated percentage change in average consumption of those households actually purchasing some of the product and (*b*) the adjustment in the proportion of consumers. If the cross-sectional data set is a representative sample of the entire population of interest, e.g., all households, then this second component can be interpreted as the market participation rate. This derivation of the total elasticity in terms of price as the sole demand determinant can be extended to include income and other demand determinants as well.

Statistical Model

The model used in this study was developed by Tobin in 1958. It can be utilized to estimate simul-

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taneously from cross-sectional data adjustments in both the market participation rate and in average quantity purchased by households that purchased some of the product as a result of changes in price, income, or other demand determinants.

With cross-sectional data each household faces a particular price of the product concerned and usually can be characterized by a set of socioeconomic variables. Some households purchase a positive quantity of a particular commodity while others make no purchases. A hypothetical cross-sectional sample of observations showing the quantity purchased at specified prices is illustrated in the first two columns of table 1. In this example, the dependent variable (quantity purchased) has a limiting value of zero because negative purchases are not observed. Accordingly, the quantity purchased is viewed, under the Tobin model, as an index "I" such that

$$I_i = \beta_o + \beta_1 p + \Sigma \beta_j X_{ij}, \tag{6}$$

where p is the price of the commodity and the X_{ij}'s are independent variables. The β_j's are parameters specifying the relationship between the dependent and independent variables. The quantity variable, then, is redefined, since it cannot be negative,

$$q_i = \begin{cases} 0 \text{ if } I_i < 0 \\ I_i \text{ if } I_i \geq 0. \end{cases}$$

Above a certain price, I is negative, so q (quantity purchased) is defined as zero. Below this price, I is positive and, therefore, q is positive. Households differ from each other in their purchasing behavior regarding I, which is not fully accounted for in either the independent variables (price, income, etc.) or the lower limit "0." These differences are assumed to be random and reflected in a random variable "ϵ" with mean 0 and standard deviation σ. Therefore, household purchasing behavior is assumed to be

$$q_i = \begin{cases} 0 & \text{if} \quad I_i - \epsilon_i < 0 \\ I_i - \epsilon_i & \text{if} \quad I_i - \epsilon_i \geq 0, \end{cases}$$

where ϵ plays the role of a random disturbance.

The first four households observed (table 1) did not purchase any product. For these households, it is assumed that their index $I_i(\beta_o + \beta_1 p + \sum_{j=1} \beta_j X_{ij})$ falls short of ϵ_i so that $I_i - \epsilon_i < 0$. The distribution of I may be derived from the distribution of ϵ. The probability of observing a household that does not purchase any product is

$$P\{q = 0|I\} = \text{Prob}\{I - \epsilon < 0|I\} = 1 - F\left(\frac{I}{\sigma}\right),$$

where $F(z)$ is the standard normal cumulative distribution at z. A more general case of the Tobin model allows the limiting value of the dependent variable to be any value, not just zero as in this example. Since the relation between prices and the index I is negative, the higher the price $\left(\text{the smaller } \frac{I}{\sigma}\right)$, the greater will be the probability of observing zero purchases and vice versa.

The probability of observing a household that purchases some of the product q is defined as

$$\text{Prob}\{q > 0|I\} = \text{Prob}\{\epsilon < I|I\} = F\left(\frac{I}{\sigma}\right).$$

Table 1. Hypothetical Cross-sectional Sample of Household Purchases

Household Number	Price	Quantity Purchased (q_i)	Tobit Model Probability	Elements of the Likelihood Function
1	1.0	0.0	$1 - F\left(\frac{I_1}{\sigma}\right)$	$1 - F\left(\frac{I_1}{\sigma}\right)$
2	3.0	0.0	$1 - F\left(\frac{I_2}{\sigma}\right)$	$1 - F\left(\frac{I_2}{\sigma}\right)$
3	4.5	0.0	$1 - F\left(\frac{I_3}{\sigma}\right)$	$1 - F\left(\frac{I_3}{\sigma}\right)$
4	5.5	0.0	$1 - F\left(\frac{I_4}{\sigma}\right)$	$1 - F\left(\frac{I_4}{\sigma}\right)$
5	7.0	2.0	$F\left(\frac{I_5}{\sigma}\right)$	$\frac{1}{\sigma} f\left(\frac{I_5 - 2}{\sigma}\right)$
6	6.0	3.0	$F\left(\frac{I_6}{\sigma}\right)$	$\frac{1}{\sigma} f\left(\frac{I_6 - 3}{\sigma}\right)$
7	2.0	5.0	$F\left(\frac{I_7}{\sigma}\right)$	$\frac{1}{\sigma} f\left(\frac{I_7 - 5}{\sigma}\right)$

The model probability associated with each observation in the sample is given in column 3 of table 1.

The likelihood of observing this sample of observations, given the assumptions about the underlying distribution of the index I, is the product of a set of cumulative probabilities for observations 1 through 4 and probability densities for observations 5 through 7. These are given in column 4 of table 1.

In general terms, then, the probability of observing a given sample is

$$L = \prod_{i=1}^{S} \left(1 - F\left(\frac{I_i}{\sigma}\right)\right) \prod_{i=S+1}^{T} \left(\frac{1}{\sigma} f\left(\frac{I_i - q_i}{\sigma}\right)\right),$$

where S households were observed to have zero purchases and $T - S$ were observed to have positive purchases.

The Tobin model estimates the values of the β's and σ that maximize the probability of observing the household purchasing behavior in the sample. This is done by differentiating lnL with respect to the β's and σ. This procedure yields nonlinear normal equations. These normal equations are solved using an iterative procedure for those maximum likelihood values of β's and σ (Maddala, pp. 171–80).

The expected value of q for any value of p (and other demand determinants) can be shown to be

$$(7) \qquad E(q|I) = IF\left(\frac{I}{\sigma}\right) + \sigma f\left(\frac{I}{\sigma}\right),$$

and the estimated expectation is

$$(8) \qquad \hat{q} = \hat{I}F\left(\frac{\hat{I}}{\hat{\sigma}}\right) + \hat{\sigma} f\left(\frac{\hat{I}}{\hat{\sigma}}\right).$$

Calculating values of $\hat{q}$ for selected prices (prices first determine the estimated index "I," which in turn is used in the above equation (8) to calculate $\hat{q}$) yields the estimated demand curve.

The elasticity of $\hat{q}$ with respect to price, income, or any demand determinant, denoted X_i, is

$$(9) \qquad E_{\hat{q}\cdot X} = \left(\frac{\partial E(\hat{q}|\hat{I})}{\partial X}\right)\left(\frac{X}{E(\hat{q}|\hat{I})}\right),$$

where

$$\frac{\partial E(\hat{q}|\hat{I})}{\partial X} = \hat{b}XF\left(\frac{\hat{I}}{\hat{\sigma}}\right).$$

This elasticity represents the total response to a demand determinant change. The component elasticities, quantity, and market participation, can be derived by subtracting the market participation elasticity, $E_{PR\cdot X}$, defined as

$$E_{PR\cdot X} = \frac{\hat{b}}{\hat{\sigma}} f\left(\frac{\hat{I}}{\hat{\sigma}}\right)\left[\frac{X}{F\left(\frac{\hat{I}}{\hat{\sigma}}\right)}\right] = \frac{\hat{b}X}{\hat{\sigma}}\left[\frac{f\left(\frac{\hat{I}}{\hat{\sigma}}\right)}{F\left(\frac{\hat{I}}{\hat{\sigma}}\right)}\right],$$

from the total elasticity (9) to yield the quantity elasticity (participation held constant):

$$E_{\hat{q}\,X} = E_{q^*\,X} - E_{PR\,X}.$$

An Empirical Application

The Tobit model was applied to panel data on dairy product purchases to derive total elasticity estimates (Thraen, Hammond, Buxton). The demand equations were specified such that household purchases for four major dairy products (fluid milk, nonfat dry milk, processed cheese, and natural cheese) were a linear combination of (*a*) product price, (*b*) household income, (*c*) household consumption and size, (*d*) education of household head, (*e*) occupation of household head, (*f*) employment status of housewife, and (*g*) race of household. The data used for estimation was panel data on dairy product consumption by U.S. households for 1972–73 (Market Research Corporation of America panel data provided by United Dairy Industries Association). The general form of the estimated index for each product was

$$I_i = b_o + b_1 p_i + b_2 Y_i + b_3 Y_i^2 + \sum_{j=1}^{n} b_j X_{ij},$$

where I_i is index of consumption by the ith household; p_i, product price facing the ith household; Y_i, income for the ith household; X_{ij}, jth demographic characteristics of the ith household; and b_0, b_1, b_2, b_3, and b_j are estimated parameters.

Household incomes and size were included in quadratic form to account for the possibility that higher values, *ceteris paribus*, have a different marginal effect on the quantities of product purchased.

The significance of the set of coefficients for each demand equation was checked by use of the −2 log likelihood ratio (Tobin). The equations were statistically significant at the 1% probability level for all four products. The parameters on the income variable were significant at the 10% probability level for all products. The parameters on price had the expected sign for all products and were significant at the 10% probability level for all products. The elasticities for price and income relating to both entry-exit and quantity adjustments which were derived from the Tobit model are given in table 2 for four dairy products. These elasticities are arc estimates for small changes in price and income levels.

Influence of Product Price on Household Consumption

For fluid milk, the entry or exit of households accounted for about one-fourth of the total adjustment to a price change. For nonfat dry milk, entry or exit of households into the market accounted for about 80% of the total market adjustment to both price and income changes.

Table 2. Household Purchase Response to a 1% Change in Average Price or Household Income

	Response to Price Change			Response to Income Change		
	Total Response	Market Participation Response	Quantity Response	Total Response	Market Participation Response	Quantity Response
Fluid milk	−.88	−.23	−.65	+.12	+.03	+.09
Nonfat dry milk	−1.92	−1.50	−.42	+.45	+.36	+.09
Process cheese	−.62	−.43	−.19	+.04	+.03	+.01
Natural cheese	−.23	−.12	−.11	+.25	+.13	+.12

For nonfat dry milk, a 1% change in the average retail price will alter the quantity consumed an estimated 1.92%—1.50% due to entry or exit of households from the market and 0.42% due to adjustments in consumption of households purchasing nonfat dry milk (table 2).

Influence of Income on Household Consumption

For all products, income elasticity is relatively small. Nonfat dry milk is the most elastic (0.45); fluid milk is the most inelastic (0.12). However, inspection of the component elasticities indicates that the percentage quantity adjustment of actual consumers is the same for both fluid milk and nonfat dry milk. The disparity in total elasticities is a result of much different participation elasticities. These components indicate that market participation is relatively more stable for fluid milk than for nonfat dry milk.

Summary

The Tobit model was applied to cross-sectional data on dairy product consumption. Results show that for three of the four products analyzed, the participation rate adjustment is the most important component of the price and income elasticities. For both price and income changes, entry or exit from the market accounted for more than half of the market response for all products except fluid milk.

One implication of this finding, with respect to dairy products, is that price and income elasticities derived from cross-sectional data, which measure only the quantity response to price changes for consuming households actually purchasing a product, will underestimate significantly the total market response to price changes.

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The Farmer Decision Process in Purchasing Broiler Feeds

Thomas F. Funk and Frank C. Tarte

In formulating marketing strategy, the decision maker must rely extensively on an understanding of the purchasing decision process of present and potential customers. Because the objective of the market planner is to influence this decision process, the success of such efforts depends on a thorough understanding of how the buying decision is made. This, in turn, necessitates the use of a model that gives structure to the decision process. The more specific this model is to the actual marketing situation, the more useful it will be in the market-planning process.

Existing models of the buying decision process (Engel, Kollat, Blackwell; Howard and Sheth; Nicosia; Webster 1965) are very general. As a result, while they tend to structure the buying decision process by identifying critical variables and relationships, the models do not "describe a specific buying situation in the richness of detail required to make a model operational for the marketing manager analyzing opportunities to influence buying decisions" (Webster 1974, p. 34).

In purchasing supplies, the farmer is in a similar situation to the industrial purchasing agent. The products purchased are not for immediate consumption, but rather are inputs to a production process. Thus it is reasonable to expect that the farmer's purchasing behavior, at least in structure, resembles that of an industrial buyer. As a result, a general model of the industrial buying process which structures the fundamental elements of the decision process can provide a framework for the analysis of the farmer buying process.

The objective of this article is to report the results of a research project that used an applied or operationalized decision process model to analyze a specific buying decision in considerable detail. The specific application is to the farmer decision process in purchasing broiler feeds. This type of research was possible in Ontario because most broiler producers are not vertically integrated, hence able to make independent purchasing decisions.

Model and Data

The general model used to structure the analysis was the four-part descriptive model of the industrial buying process developed by Webster in 1965. This model consists of the following stages: (*a*) recognition of a problem to be solved by a purchasing decision; (*b*) the organizational assignment of buying responsibility; (*c*) gathering of information for the purposes of identifying alternative problem solutions and establishing evaluation criteria; and (*d*) evaluation and selection of a product and supplier. With the exception of the assignment of buying responsibility, excluded because such activity is obviously not relevant to most farming operations, this model provided the framework around which we analyzed the farmer decision process.

Data for this research were collected through a survey of Ontario broiler producers. Using a list supplied by the Ontario Chicken Producer's Marketing Board, a random sample of broiler growers was selected for personal interviews. Usable interviews were obtained from 100 producers in a seven-county area of southwestern Ontario. Tarte (pp. 13–17) provides a detailed discussion of questionnaire design and sampling procedures.

Results

The decision process begins when the farmer recognizes a problem. In the context of a purchasing decision, a problem occurs when a difference exists between a farmer's expectations of a product and the actual level of performance achieved in using the product. A problem, therefore, can be caused by a change in either performance or expectations arising from a number of sources. In this research the sources investigated were other growers, marketing action, quality and service, and cost and performance.

To investigate sources of problem recognition, the sample farmers were asked to respond to a series of statements designed to depict situations which might cause them to recognize a problem with their feed brand or suppliers. For each situation each farmer was asked to indicate whether or not that situation (*a*) definitely would cause him to doubt or question the use of his current feed brand, (*b*) might cause him to doubt or question the use of his current feed brand, or (*c*) definitely would not cause him to doubt or question the use of his current feed brand. For any of the statements a response of (*a*) or (*b*) indicates that the situation described by that statement can be a potential problem source to the farmer.

The first category considered in table 1 is the

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Table 1. Situations Causing Farmers to Recognize Problems with Their Feed Brand or Supplier

	Percentage of Farmers Reporting		
	Definitely Would Cause Doubts	Might Cause Doubts	Definitely Would Not Cause Doubts
Influence of other growers			
1. I thought that other growers were doing better with another feed company	6	48	46
2. Other growers suggested that I might do better with a different feed supplier.	3	46	51
Influence of marketing action			
1. A very respectable feed company seemed anxious that I try their feed at least once, on one flock or in one building.	8	48	44
2. I found another feed firm that had a better reputation.	7	35	58
3. I could see from the results shown to me by a trustworthy salesman that I might do better if I changed feeds.	3	38	59
4. A new dealership opened closer to my farm.	2	18	80
5. Feed company literature suggested that I might be doing better.	0	26	73
Concern for quality and service			
1. The feed mill service was not very reliable.	35	51	14
2. The feed salesman did not always provide me with good service.	7	58	35
3. I thought there were too many fines in the feed.	10	47	42
4. The appearance of the feed did not appeal to me.	10	42	47
Concern for feed cost and performance			
1. I thought the feed price was too high for the feed conversion I was getting.	36	46	18
2. The return per bird over feed and chick costs on two crops was lower than I had anticipated.	28	50	22
3. I thought the price per ton for the feed was too high.	18	59	22
4. The feed conversion appeared to be too high.	12	63	25

influence of other growers. The response to the two questions in this area tend to confirm the point that other growers may cause farmers to recognize problems by increasing their expectations. While only a small percentage of growers indicated that the apparent success or suggestions of other growers definitely would cause them to have doubts about their current feed brand, a substantial proportion indicated that it might cause some doubts. For about half of the producers, the influence of other growers has no apparent effect on problem recognition.

The second source of problems is related to the influence of marketing action. Through certain activities a feed firm can cause a farmer to increase his expectations and, as a result, to recognize a problem. The responses to statements in this category show that while some types of firm-initiated marketing action can be effective in causing problem recognition, others have limited effectiveness.

Problems can also arise from inadequate performance. Responses to the third group of statements in table 1 indicate that below-standard quality and service performance can be an important source of problems for farmers. In this regard, unreliable feed mill and salesman service appear to be a more important source of problems than product quality consideration.

The final, and most important, source of problems relates to feed cost and performance. In general, responses to the four cost and performance-oriented situations show a strong tendency for problems to be recognized as a result of higher than expected prices or feed conversion and lower than anticipated returns.

Results from the survey show that return per bird over feed and chick costs was by far the measure most widely used by the sample producers to evaluate the success of their broiler operations. Anticipating this, some follow-up questions were asked in an attempt to quantify this measure. First, each producer was asked to estimate what return over feed and chick cost he expected to achieve over the long run. Responses to this question indicated that with a return of approximately 30¢ per bird, the average producer would be reasonably satisfied with the performance of his broiler operation.

Having established the above measure, two additional questions were asked to indicate the distance between the desired and actual level of goal attainment that would cause the farmer to recognize a problem with his feed supplier. The producers were asked to estimate first, the level to which the return over feed and chick costs would need to drop for three or four crops before these poor returns would cause them to experience definite doubts or problems with their feed input and, second, the level to which returns would have to drop for only one crop to bring about the same situation. Returns 7¢ (or approximately 25%) below expectations for three or four crops or 9¢ (30%) below for one crop were indicated as sufficient reason for most producers to recognize doubts or problems with their broiler operation and to consider changing brands and/or suppliers.

The Search Process

Once a problem has been recognized, the grower moves to the second stage of the decision process, the search for information. Search is a series of efforts to obtain specific information concerning feed brands and dealers, feed prices and conversions, and other related information. Search activities, as defined in this research, include those activities growers use in gathering evaluative information about alternative dealers and brands. A common characteristic of these activities is that they require some commitment of time, effort, and, perhaps, expense on the part of the grower. A list of the activities considered, together with a frequency distribution of producer participation, is shown in table 2.

The results in table 2 show considerable variation among farmers in the degree to which they participate in searching activities. In an attempt to differentiate farmers on the basis of their searching behavior, we used simple cross-classification analysis to relate several farm and farmer characteristics to overall participation in search activities. For this analysis, the sample producers were categorized into two groups on the basis of their reported participation in the search activities listed in table 2. Tarte (pp. 93–99) describes the procedures used to make this and other classifications in the analysis.

We present the results of this analysis in table 3 and show, first of all, that farmers with higher profit expectations and those who perceive large and significant differences among brands are likely to engage in a greater amount of search activities than are other farmers. In addition, the results show that larger farmers (both in terms of their broiler enterprise and total farm business) as well as younger farmers, are more likely to be classified in the high search group.

The Choice Process

The third step in the decision process is evaluation and selection of a feed source. In the farmer decision-process model, this process consists of three parts: identification of alternative suppliers, establishment of decision criteria, and final selection of a supplier. Growers were asked to list their available feed source alternatives in the event they were to change from their present supplier. In responding to this question, each listed an average of

Table 2. Farmer Participation in Searching Activities

	Responses				
Question	More Than Three Times a Year	Three Times a Year	Twice a Year	Once a Year	Never
How often do you telephone or personally contact other feed companies?	16	5	10	2	67
How often do you discuss the pros and cons of another company's feed with their representative?	33	4	19	16	28
How often do you talk to other broiler producers about their feed results and supplies?	47	22	13	9	9
	Every Time They Call	Every Other Call	Twice in Every Five Calls	Once in Every Five Calls	Never
How regularly do you check feed prices with salesmen?	58	8	4	15	15
How often do you check the feed conversions and results of other growers with salesmen?	19	15	12	18	35
	No	Yes			
Do you attend poultry shows?	33	67			
Do you attend company seminars on broilers?	45	55			
Do you attend Broiler Board zone meetings?	19	81			

Table 3. Farm and Farmer Characteristics Related to Searching

Characteristics	Search Groups Low	High	Chi-Square
Profit expectations			
25¢ or less	15 (71%)	6 (29%)	
26¢ to 33¢	22 (46%)	26 (54%)	7.80[b]
34¢ or more	8 (31%)	18 (69%)	
Perceived difference in feeds and feed sources			
Little	32 (64%)	18 (36%)	8.74[a]
Considerable	15 (32%)	32 (68%)	
Broiler quota			
Less than 12,000	18 (78%)	5 (22%)	
12,000 to 30,000	22 (46%)	26 (54%)	11.24[a]
Over 30,000	9 (32%)	19 (68%)	
Gross farm income			
Less than $100,000	32 (62%)	20 (38%)	5.38[a]
$100,000 or greater	17 (36%)	30 (64%)	
Grower's age			
Less than 45 years	15 (37%)	26 (63%)	3.83[b]
45 years and older	34 (59%)	24 (41%)	

[a] Significant at the 99% level.
[b] Significant at the 95% level.

four alternative suppliers. The average distance to these alternative suppliers was 34.6 miles, compared to an average distance of 27.5 miles for present feed sources.

Correlation analysis was used to study the relationship between search behavior and number of alternatives considered. Results of this analysis indicated that producers with higher search scores considered a significantly larger number of alternatives than other broiler growers.

In making their broiler feed-purchase decision, producers compare alternative brands along several dimensions. An attempt was made to measure the overall importance of eight of these factors: supplier reputation, brand reputation, feed conversion, feed cost per pound of meat produced, cost per ton of feed, feed mill service, salesman service, and return per bird.

To measure the relative importance of the above factors, a purchase criteria scale was developed using the comparative judgment technique (Green and Tull, p. 184). This procedure involves deriving an interval scale from comparative judgments of the type, "price is more important than service." Scale values were estimated from data in which respondents made comparative judgments for each possible pair of the factors. The resulting purchase criteria scale shows that growers consider four highly objective factors—return per bird, feed cost per pound of meat produced, feed conversion, and feed cost per ton, in descending order, to be the major criteria in selecting a source of supply, and other less objective factors to be of secondary importance.

Following evaluation, the producer must make a decision as to which source to use in the future. As a result of this decision, the producer will either continue to use the present brand, or switch to a new brand or supplier. The extent to which a grower does or does not change brands is a measure of brand loyalty.

To investigate the extent of brand loyalty for broiler feeds, growers were asked to give a complete history of feed brands and suppliers used since beginning their present broiler operation. All purchases were recorded on a crop basis.

Analysis of the feed-purchasing history data revealed that the average grower had completed thirty-five crops, or had been in business slightly under nine years. During this time the average producer used 3.5 different brands of feed. Dividing the number of crops by the number of brands gave an average number of crops per brand of approximately fourteen. Thus, the average farmer in the sample switched brands every fourteen crops, or approximately every three and one-half years.

The relationship between brand loyalty and several important farm and farmer characteristics was investigated using simple cross-classification analysis. For this analysis the sample farmers were categorized into two loyalty groups on the basis of the average number of consecutive crops grown before switching to a different feed brand. Using this procedure, approximately one-half of the producers were classified in each of the two loyalty groups.

Table 4 presents the results of this analysis and shows, first of all, that farmers with higher profit expectations and those who engage in a greater amount of search activities are likely to switch feed brands more often than other farmers. In addition, the results show that the grower's age and broiler business experience are related to brand loyalty in the sense that younger, less-experienced farmers

Table 4. Farm and Farmer Characteristics Related to Brand Loyalty

Characteristics	Loyalty Groups Nonloyal	Loyal	Chi-Square
Profit expectations	%	%	
25¢ or less	6(29)	15(71)	
26¢ to 33¢	27(56)	21(44)	5.90[b]
34¢ or more	16(62)	10(38)	
Search groups			
Low	19(39)	30(61)	4.45[b]
High	31(62)	17(38)	
Grower's age			
Less than 45 years	28(67)	14(33)	6.04[a]
45 years and older	22(38)	36(62)	
Broiler business experience			
10 years or less	42(76)	13(25)	31.70[a]
More than 10 years	8(18)	37(82)	

[a] Significant at the 99% level.
[b] Significant at the 95% level.

are much more likely to be nonloyal than other farmers.

Marketing Implications

The major thrust of this note is that generalized decision process models can provide a meaningful conceptual framework for formulating marketing strategies; however, unless they can be made operational for the marketing manager who analyzes opportunities to influence buying decisions, such models lack practical usefulness and broad appeal among market planners. The purpose of this final section is to illustrate some of the major marketing implications arising from the present application of a decision process model to broiler producers, and to demonstrate the type of marketing insights that can be gained through such an application of an applied model. Some of the major marketing implications follow.

In a quasi-industrial marketing situation, problem recognition can arise from several sources. Although objective economic criteria such as cost and performance variables are of fundamental importance, other sources which raise expectations can play a role in increasing buyers' expectations.

Efforts directed toward causing problem recognition by changing expectations seem to be more effective when channeled through "third party" or "impersonal" sources. This is commonly done in farm input marketing through the use of testimonial advertising and other such means; however, the potential for increased use of these sources appear to be greater than exemplified in current practice. Although not as important, efforts to cause problem recognition through direct company marketing programs can have some effect.

Broiler producers seem fairly tolerant to changes in the performance level of their feed input. Reductions in the vicinity of 25% to 30% in return per bird over feed and chick costs seem quite high. Most likely this is a result of broiler growers' prevalent attitude that all brands and suppliers are essentially the same. As a result, feed firms wishing to pursue growth-oriented marketing strategies must pay particular attention to developing meaningful product and service differences if they are to overcome this fundamental inertia to change.

Most broiler producers claim that feed purchasing decisions are made primarily on the basis of highly objective economic criteria such as returns, feed conversion factors, and feed costs. This is probably true, but in situations where farmers perceive only small differences among major brands, this certainly increases the importance of other, more subjective criteria such as service and reputation.

Although the overall level of loyalty to broiler feeds is fairly high when compared with other inputs farmers purchase (Funk and Tarte), considerable variation among farmers is present. Of particular importance here is the fact that younger producers with less experience in broiler production and higher target profit levels tend to be brand switchers. This result implies that any growth-oriented marketing program must be attractive to this important market segment if it is to be successful.

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The Impact of Alternative Objectives on Feedlot Rations for Beef Steers

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The specification of an objective receives little attention in most agricultural production analyses. Despite general agreement among agricultural economists that few, if any, farmers are motivated exclusively by magnitude of profits, it is common simply to assume an objective of profit maximization. (Anderson, Dillon, Hardaker; Heady and Dillon).

Use of this objective is sufficient for some analyses. For other analyses, however, the observed diversity of production practices makes this simple approach inappropriate. Beef production falls into the latter category. Even if we ignore beef marketed as mature animals from the culling of breeding herds, the diversity of production practices is obvious. A 20,000-head commercial feedlot manager on the Texas plains and an Iowa farmer feeding 100 head per year do not operate similarly and probably are not motivated by the same objectives.

We attempt to quantify some of the objectives that are relevant for various groups of beef producers and to analyze the impact of these alternative objectives on beef production strategies. Five alternative objectives are defined for the feeding of a roughage (corn silage) and a corn-grain-based concentrate to beef steers to produce carcass weight gain. Additionally, using a fixed initial age and carcass weight (196 kg) and a fixed final carcass weight (295 kg), each objective is evaluated for a specific gain or over a fixed region of the response surface (see Melton). The assumption of a fixed slaughter weight is generally consistent with production of animals of a fixed U.S. Department of Agriculture (USDA) quality grade. It is appropriate to apply the analyses to carcass weight gain because the lower digestibility of roughages causes a greater portion of live weight to be undigested feed rather than beef.

Physical Production Relationships

Because initial and slaughter carcass weights are assumed fixed, it is not necessary to specify an overall production function to analyze the relevant properties of the physical production process (Heady, Sonka, Dahm). Instead, by assuming that producers are willing to consider changing rations only over specific, independent weight intervals (196–227 kg, 227–46 kg, 246–61 kg, 261–80 kg and 280–95 kg), the necessary feed relationships are embodied in isoquants of the form

$$(1) \qquad C_i = f_i(S_i) \qquad i = 1, 2, \dots, 5,$$

where C_i is kilograms dry matter of concentrate consumption required to complete the ith weight interval, and S_i is kilograms dry matter of corn silage consumption in the ith weight interval.

For this paper, we assume that the true isoquants for the specified weight intervals are of the form

$$(2a) \qquad C_i = b_{0i} + b_{1i}S_i + b_{2i}S_i^2 \qquad S_i \le K_i \quad i = 1, 2, \dots, 5, \quad \text{and}$$

$$(2b) \qquad C_i = b_{3i} + b_{4i}S_i + b_{5i}S_i^2 \qquad S_i \ge K_i \quad i = 1, 2, \dots, 5,$$

subject to the constraints that at the point K_i the two quadratic functions, 2a and 2b, for each weight interval join with a continuous first derivative (Fuller). The value of K_i may be estimated either as the inflexion point of a cubic function or by visual inspection. Good results may be obtained by either method if the estimated values of K_i are in the vicinity of the true joining points (Fuller). The estimated regression coefficients, values of K_i, and relevant statistical information are shown by weight interval in table 1.

Obviously, these isoquants are not of the typical, strictly convex (with respect to the origin) form. These grafted quadratic isoquants are continuous, with a continuous first derivative, but are sigmoid in shape—with areas of increasing and decreasing substitutability. Although this property is unusual, there is increasing evidence that it is descriptive of feed relationships between roughages and concentrates in the beef production process (Brokken, Brokken et al. 1976). This fact, coupled with an otherwise adequate statistical fit, suggests that these isoquants may be used despite the low statistical significance of some of the estimated regression coefficients.

In addition to feed relationships, it is necessary to consider the time aspects of the feeding process. Contrary to a classical textbook development of production in which time is fixed for a process, a

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Table 1. Estimated Coefficients and Relevant Statistics for the Isoquant Functions

Weight Interval	K	Coefficients[a] b_0	b_1	b_2	b_3	b_4	b_5	Mean Square Error	R^2
I (196–227 kg.)	118.8	339.49	−1.614	.0045	207.93	.60	−.0048	1352.174	.93
		(26.00)	(.860)	(.0051)	(116.19)	(1.334)	(.0035)		
II (227–246 kg.)	133.8	218.28	−1.385	.0035	97.99	.4131	−.0033	789.975	.90
		(19.21)	(.586)	(.0035)	(127.00)	(1.545)	(.0043)		
III (246–261 kg.)	83.4	236.42	−1.319	.0029	195.12	−.328	−.0030	359.663	.96
		(13.39)	(.615)	(.0055)	(53.48)	(.853)	(.0031)		
IV (261–280 kg.)	99.7	264.17	−1.793	.0054	156.21	.373	−.0055	665.738	.94
		(18.19)	(.732)	(.0058)	(97.59)	(1.460)	(.0117)		
V (280–295 kg.)	109.9	224.18	−2.204	.0101	−18.11	2.204	−.0099	475.550	.94
		(15.28)	(.556)	(.0040)	(90.83)	(1.2924)	(.0042)		

Source: Melton.

[a] Standard errors of the estimated coefficients are in parentheses below the relevant coefficients.

beef feeding ration will generally affect the animal's rate of gain. For all-silage rations, an animal's physical capacity limits consumption and thus the rate of gain. At the other extreme, an all-concentrate ration may cause physiological problems (in digestion) and subsequently reduce the rate of gain (Church).

By defining a ration in terms of the proportion of silage in the mixture, relationships between the ration and time requirements may be expressed as

$$(3) \qquad D_i = g_i(R_i) \qquad i = 1, 2, \ldots, 5,$$

where D_i is days required to complete the ith weight interval and R_i is the ration, as distinguished by its silage proportion, fed over the ith weight interval. As with the isoquants, for this paper we assume that the time-on-feed relationships are of the form

$$(4) \quad D_i = a_{0i} + a_{1i}R_i + a_{2i}R_i^2 + a_{3i}R_i^3 \qquad i = 1, 2, \ldots, 5.$$

The coefficients and relevant statistical data for the time-on-feed functions are summarized in table 2.

Models

With the relevant physical relationships thus specified, it is possible to proceed with the specification of models designed to evaluate beef feeding strategies under alternative decision criteria or objectives. In this respect, five different beef production scenarios or cases are developed.[1]

Case 1: Maximizing the Rate of Gain

Until quite recently, objectives proposed by animal scientists dealt predominately with measures of output. Recommendations were made to maximize production of milk per dairy cow, weight of beef weaned per breeding animal, or the weight gain per day of feedlot steers. These objectives are rela-

Table 2. Estimated Coefficients and Relevant Statistics for the Time-on-Feed Functions

Weight Interval	Coefficients[a] a_0	a_1	a_2	a_3	Mean Square Error	R^2
I (196–227 kg.)	48.7	−59.35	127.1825	−79.2824	9.857	.64
	(2.2)	(21.13)	(52.5004)	(34.4725)		
II (227–246 kg.)	29.4	−51.76	142.7579	−90.8565	10.886	.54
	(2.3)	(22.20)	(55.1747)	(36.2285)		
III (246–261 kg.)	30.9	−33.88	73.0655	−45.1389	3.232	.61
	(1.2)	(12.10)	(30.0638)	(19.7403)		
IV (261–280 kg.)	33.8	−50.05	105.0595	−64.2361	5.487	.69
	(1.6)	(15.76)	(39.1697)	(25.7193)		
V (280–295 kg.)	28.5	−48.85	125.7441	−81.5972	7.353	.50
	(1.9)	(18.25)	(45.3441)	(29.7735)		

Source: Melton.

[a] Standard errors of the estimated coefficients are in parentheses below the relevant coefficients.

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[1] One segment of the industry not considered is characterized by the feeding of "home-grown" crop production to beef steers. Because these producers use beef as a means of marketing their crop, an analysis of their feeding strategy would entail an analysis of crop production, which is beyond the scope of this paper.

tively simple to represent and to quantify; and when input prices are relatively low and stable, they may serve quite adequately. Initially, therefore, it is reasonable to hypothesize a producer motivated by the attainment of the maximum rate of gain per steer.

Maximizing the rate of carcass weight gain per steer under the assumed fixed initial and slaughter weights is equivalent to minimizing the number of days required to complete this fixed gain. Hence, this producer's objective may be stated mathematically in terms of previously defined physical relationships as

$$(5) \qquad \text{Min } Z = \sum_{i=1}^{5} D_i,$$

where Z is the number of days required to complete the total feeding period (from 196 to 295 kg).

This producer's optimal ration in each of the five weight intervals is then obtained by solving

$$(6) \qquad \frac{\delta Z}{\delta S_i} = \frac{\delta D_i}{\delta R_i} = 0 \qquad i = 1, 2, \ldots, 5$$

for R^*_i, the optimal level of R_i, using (4). The optimal levels of feed inputs may then be obtained by using the relationship

$$(7) \quad R^*_i = \frac{S^*_i}{S^*_i + C^*_i} \qquad i = 1, 2, \ldots, 5$$

in conjunction with isoquants, where S^*_i and C^*_i are optimal quantities of corn silage and concentrate consumed over the ith weight interval, respectively.

Case 2: Minimizing Ration Costs

Animal scientists have recently recognized that least-cost ration formulation may be more appropriate for beef feeding recommendations than maximizing the rate of gain. Producers, who have been directly affected by drastic feed price increases similarly recognize the need to minimize feed costs, under some conditions.

The producer with an objective of minimizing the cost of the ration has an objective that can be expressed as

$$(8) \qquad \text{Min } Z = \sum_{i=1}^{5} (P_c C_i + P_s S_i),$$

where Z is now feed costs over the entire feeding period, P_c is the price per kilogram dry matter of concentrate, and P_s is the price per kilogram dry matter of corn silage. Assuming the producer buys all needed feed at the start of the feeding process, or precontracts for future feed delivery at a fixed price, P_c and P_s are fixed. To obtain the least-cost feed mix for each weight interval under fixed feed prices, the marginal rate of substitution of corn silage for concentrate is equated to the negative, inverse price ratio, such as

$$(9) \qquad \frac{\delta C_i}{\delta S_i} = -\frac{P_s}{P_c} \qquad i = 1, 2, \ldots, 5.$$

By a simple process, this equality can be solved for S^*_i, and the value can be substituted back into the relevant isoquant to obtain C^*_i and eventually R^*_i by using (7).

Case 3: Minimizing Total Feeding Costs

From a real world standpoint, neither Case 1 nor Case 2 is appropriate. With feed costs ignored, all emphasis is on time in Case 1. The opposite holds true in Case 2 and time plays no role in the decision process. As long as time on feed has a nonzero cost (resulting from labor and capital costs, for instance) and the ration affects the time required to complete the production process, both feed and time obviously should be considered in the decision process.

With a fixed level of gain and fixed feed prices, maximizing profit per animal is equivalent to minimizing total feeding costs, including time, against the fixed revenue. Mathematically, this objective may then be expressed as

$$(10) \quad \text{Min } Z = \sum_{i=1}^{5} (P_c C_i + P_s S_i + P_d D_i),$$

where Z is in this case the total cost of feeding over the entire feeding period, and P_d the nonfeed variable cost per day an animal is on feed.

The optimal ration over each weight interval is only slightly more difficult to obtain for this objective. Its solution makes use of the physical relationships for each weight interval and equation (7) to solve the first-order conditions:

$$(11) \quad \frac{\delta Z}{\delta S_i} = P_c \frac{\delta C_i}{\delta S_i} + P_s + P_d \frac{\delta D_i}{\delta R_i} \left(\frac{\delta R_i}{\delta S_i} + \frac{\delta R_i}{\delta C_i} \frac{\delta C_i}{\delta S_i} \right) = 0 \quad i = 1, 2, \ldots, 5,$$

for the optimal corn silage level, S^*_i. This value may then be used to sequentially obtain C^*_i, R^*_i, and D^*_i. Obviously, the optimal level of corn silage fed in each weight interval, and thus the optimal ration and time on feed, is dependent upon the prices of all factors in equation (11).

Case 4: Maximizing Profit Per Day

For the producer who can replace each pen of steers as they are slaughtered, none of the three previous cases may be appropriate. The first three objectives are concerned with only one completion of a feeding process. However, a producer who wishes to keep facilities in continual use no longer is concerned with optimization over a single feeding cycle, but rather with optimization over a fixed planning horizon that may include the purchase and slaughter of many groups of animals. Hence, his feeding decision is influenced by both profits per animal and the animal turnover rate, or time required per animal.

It is reasonable in such continuous feeding situations to assume initially an objective of maximizing profit per day over the entire feeding cycle (Dillon), or

$$\text{Max } V = \sum_{i=1}^{5} \P_i \left(\sum_{i=1}^{5} D_i \right)^{-1}, \tag{12}$$

where

$$\P_i = P_g G_i - (P_c C_i + P_s S_i + P_d D_i), \quad i = 1, 2, \ldots, 5, \tag{13}$$

$\P_i$ is per animal profit in the ith weight interval, P_g the price per kilogram of weight gain, and G_i the kilograms of weight gain over the ith weight interval.[2]

While this objective will maximize profit per animal over any fixed planning horizon, it may not be the most appropriate. For instance, the objective specified by (12) identically weights the profit accruing in each weight interval by $\left(\sum_{i=1}^{5} D_i \right)^{-1}$. Thus, an added dollar of profit contributes equally to the producer's objective, regardless of the time duration of the weight interval in which it is earned.

A second, more pragmatic problem posed by (12) is the determination of optimal rations to be fed over each weight interval. The first-order conditions for maximization of this objective require that

$$\frac{\delta \P_i}{\delta S_i} \left(\sum_{i=1}^{5} D_i \right) - \frac{\delta D_i}{\delta S_i} \left(\sum_{i=1}^{5} \P_i \right) = 0 \qquad i = 1, 2, \ldots, 5. \tag{14}$$

In this form it is obvious that decisions regarding the optimal ration in one weight interval are dependent upon the ration fed in all other weight intervals. Thus, a producer cannot determine the optimal ration for any given weight interval without determining the ration for all intervals. This interdependence is not only inconsistent with our previously stated assumption of independent weight intervals, but also requires that the solution be obtained by an iterative procedure.

An alternative objective that preserves the independence of the weight intervals and approximates (12) is obtained by assuming that the producer maximizes the sum of profit per day within each weight interval, or

$$\text{Max } Z = \sum_{i=1}^{5} \frac{\P_i}{D_i}. \tag{15}$$

Hence, within the context of this paper it is assumed that the producer's objective is defined by (15). The ration that maximizes daily profit in each weight interval is then obtained simply by solving for the value of S_i that satisfies the conditions

$$\frac{\delta Z}{\delta S_i} = 0 \qquad i = 1, 2, \ldots, 5, \tag{16}$$

and subsequently solving for C^*_i, R^*_i, and D^*_i as previously described. In this case, the value P_d is a constant that will not be present in (16) and thus will not affect the value of S^*_i. Instead, the value of time is reflected in what might be called an "opportunity cost" manner (Stigler).

Case 5: Minimizing Cost Per Day

In Cases 1 through 4, no reference has been made to the ownership of the animals being fed. The stated objectives implicitly assume that the producer owns the steers or behaves as if he does. However, some commercial feedlots do not own the animals but only contract to supply custom feeding services. For this paper we assume that the contract provides for the feedlot operator to receive a fixed revenue per animal per day plus the cost of feed consumed. Out of the fixed daily revenue, the feedlot operator pays all nonfeed costs.

If the fixed feedlot facilities are fully utilized, this feedlot operator faces an interesting situation. In the short run, the feedlot's profit is maximized by maximizing the number of days an animal is on feed (so long as the contractual daily revenue equals or exceeds P_d). In the longer run, however, the feedlot operator must be concerned with customer satisfaction, and thus customer profits, if he is to have animals available to feed in the future.

One possibility for combining these two criteria is to assume that the feedlot operator minimizes the daily cost per animal over the entire feeding cycle, or

$$\text{Min } V = \sum_{i=1}^{5} (P_c C_i + P_s S_i + P_d D_i) \left(\sum_{i=1}^{5} D_i \right)^{-1}. \tag{17}$$

Thus, under the assumptions of fixed prices and gain, for a given number of days the profit per animal of the animal's owner is maximized by (17). Alternatively, when costs are held fixed, profit per animal for the feedlot operator is maximized by (17).

As in Case 4, however, such a formulation results in optimal ration decisions in one weight interval that are dependent upon the rations fed in all other weight intervals. Thus, the assumed independence of weight intervals is violated and solutions for the optimal ration in each interval can be obtained only iteratively. The objective is therefore respecified so that the custom feedlot operator minimizes the sum of daily costs within each weight interval, or

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[2] It is realized that the total revenue from feeding $\sum_{i=1}^{5} P_g G_i$, is not received until completion of the feeding process, and further, that because of USDA quality grades, P_g may vary across weight intervals. Under the stated assumptions of fixed gain, however, P_g may be assumed fixed with $P_g G_i$ in revenue accruing to the ith weight interval.

$$(18)\quad \text{Min } Z = \sum_{i=1}^{5} \frac{(P_c C_i + P_s S_i + P_d D_i)}{D_i}.$$

Clearly, there are similarities between this objective and the one specified for Case 4. The optimal ration in each weight interval is determined in the same manner for both objectives by solving equation (16), for S^*_i, and P_d does not directly enter either decision. The main difference is that in Case 4 revenue is fixed over a weight interval, but daily revenue varies as the time required to complete the interval varies. In this case, daily revenue is fixed by the custom feeding contract.

Results

Because of the varying conditions which confront beef producers, it is inappropriate to label one of the preceding objectives as good and another as bad. Instead, we can illustrate the impact of an objective by calculating optimal rations and time requirements for each objective over a range of relative prices. This illustration is accomplished by using P_g = \$1.125, P_d = \$.20, and P_c = \$.118 while P_s equals .0735, .1470, or .2205. The three silage: concentrate feed price ratios thus generated (.6226, 1.2455, and 1.8684, respectively) correspond to approximately twice the range in relative roughage: concentrate price ratios facing the feedlot industry during the 1972–74 period.

For each of these resulting sets of relative prices, it is possible to solve for the optimal ration to be fed over each weight interval under each of the five objectives, using separable programming. This modification of linear programming allows for the inclusion of nonlinear constraints, such as the isoquant and time-on-feed functions previously specified, in the model. In addition, the attainment of a global, rather than a local, optimum may be verified by examination of the dual solution.

Total feed consumption, obtained as the sum of the optimal consumptions in each weight interval, is used to compute an overall ration (R'). Total days (D') required to complete the feeding process are similarly obtained by summing the days required in each weight interval. These two results are then combined with prices to compute total costs and per animal profit on a per feeding cycle and a per year basis as summarized in table 3.

Theoretically, large differences in profits among objectives would enable the objective with much higher profits to increase its market share until the less efficient objective is eliminated from the industry. Case 1, which fails to recognize ration changes in response to relative price changes, is a candidate for such elimination. Objectives represented by Cases 2 through 4 generally produce results similar in ration, profit per animal, and response to relative price changes. Under each price ratio, Case 3 produces the greatest per animal profit. Case 1 results in the least profit per animal, with a profit difference of over \$20.00 per animal per feeding cycle compared to Case 3 under the .6226 and 1.8684 price ratios. For the intermediate feed price ratio, Case 5 has the lowest profits, with a profit difference of \$5.25 per animal as compared to Case 3.

With the exception of Case 1, each objective produces a decrease in the silage proportion in the ration as P_s increases, but at slightly different rates. Case 5, which never reaches an all-silage ration under the prices considered, shifts more drastically than the others while Case 3 shifts most gradually and never results in a ration with no silage. Case 4 is quite similar to Case 3 and is characterized by the feeding of more silage and the use of less time per feeding cycle while per animal profits are positive.

Table 3. Estimated Optimal Rations, R^*_i as Defined in (7) and Profitability of Feeding Beef Steers under Alternative Objectives and Feedprice Ratios (P_s/P_c)

	Feed Price Ratio of .6226 Where Objective Is				
Item	Case 1	Case 2	Case 3	Case 4	Case 5
Optimal ration (R^*_i):[a]					
Weight interval I	1.00	1.00	1.00	1.00	.99
Weight interval II	.23	1.00	1.00	1.00	.93
Weight interval III	.34	1.00	1.00	1.00	.97
Weight interval IV	.35	1.00	1.00	1.00	1.00
Weight interval V	.26	1.00	1.00	1.00	.97
Overall (R')	.47	1.00	1.00	1.00	.97
Days on feed (D')	136	141	141	141	147
Profit/head (\$)	41.98	67.02	67.02	67.02	55.80
Annual turn-over rate[b]	2.68	2.59	2.59	2.59	2.48
Annual profit/head (\$)	112.51	173.58	173.58	173.58	138.55

[a] To minimize the previously mentioned digestive problems associated with the feeding of 100% concentrate rations for long periods of time, the optimal ration is constrained to include a minimum of 10% silage in each of the first two weight intervals and 5% silage in each of the remaining weight intervals. Optimal rations at their lower silage limit are identified by an asterisk (*).

[b] Computed as 365/D'.

Table 3. Continued

Feed Price Ratio of 1.2455 Where Objective Is					Feed Price Ratio of 1.8684 Where Objective Is				
Case 1	Case 2	Case 3	Case 4	Case 5	Case 1	Case 2	Case 3	Case 4	Case 5
1.00	.13	.15	1.00	.10*	1.00	.10*	.10*	.10*	.10*
.23	.10*	.16	.18	.10*	.23	.10*	.10*	.10*	.10*
.34	.05	.15	.06	.05*	.34	.05*	.05*	.05*	.05*
.35	.21	.21	.21	.05*	.35	.05*	.08	.05*	.05*
.26	.25	.25	.25	.05*	.26	.08	.12	.05*	.05*
.47	.14	.14	.37	.07	.47	.08	.09	.07	.07
136	148	144	140	158	136	156	152	158	158
2.51	4.48	5.01	4.98	−.24	−29.54	−6.49	−6.17	−6.39	−6.39
2.68	2.47	2.53	2.61	2.31	2.68	2.34	2.40	2.31	2.31
6.73	11.07	12.68	13.00	−.55	−79.16	−15.19	−14.81	−14.76	−14.76

After the zero-profit point, however, Case 4 produces rations requiring less silage and more time than Case 3.

In this respect it should be recognized, however, that the reduction in time associated with high silage levels may be an artifact of the estimation rather than a physical phenomenon. For instance, the time-on-feed functions indicate that the number of days required increases from the minimum identified for Case 1 to a maximum in the vicinity of $R_i = .7$ to .8. While this finding is consistent with animal science expectations (Church), we currently consider the results to be statistically unreliable in this area of the isoquant. Two additional years of feeding experiments are being implemented to establish the relationship.

Application of Results

The results are applicable only over one feeding period and for fixed prices. Under actual market conditions, of course, prices are seldom fixed over a year. Profit differences between some of the five cases are small; however, multiplied over many animals and time periods the differences can be important. The results also indicate that the most profitable objective for one feeding period (Case 3) may not be the most profitable over a longer period of time.

The small profit differences among Cases 2 through 5 provide some justification for the assumption of profit maximization made in most production analyses. As a guide for producers, its simplicity may outweigh the added costs associated with the implementation of an alternative objective. For an analysis of aggregate beef supply or factor demand, however, the errors introduced by such an assumption and their imputed costs can be sizable when multiplied over large numbers of animals. Errors also have greater potential significance when an alternative objective is concentrated regionally or by size of feedlot or both.

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Welfare Analysis of Long-Term Forest Products Price Stabilization: Note

R. G. Cummings and R. N. Johnson

In a recent paper in this *Journal*, Adams, Haynes, and Darr (A-H-D) examine alternatives to the U.S. Forest Service's current timber policy of nondeclining even-flow harvest levels from national forests. A-H-D's alternatives are those wherein harvests from national forests are regulated to stabilize either stumpage prices or end-product prices in U.S. markets over the period 1978 to 2000. Given the assumption of rising U.S. demand for timber products over this period, A-H-D not surprisingly demonstrate the necessity for increasing levels of timber harvests from national forests for either program of price stabilization.

The major thrust of the A-H-D argument is that a policy designed to stabilize prices (either stumpage or end product) would increase social welfare relative to the output stabilization policy currently used by the U.S. Forest Service; "social welfare" is the sum of producer and consumer surplus plus changes in the value of timber inventories. Comparative measures for producer-consumer surplus under output stabilization, and end-product or stumpage price stabilization, policies are generated via a simulation model wherein nondiscounted values are summed over the years 1978–2000.

The purpose of this brief communication is twofold: first, we wish to call attention to two particularly important biases implicit in the structure of A-H-D's analytical framework as these biases relate to conclusions concerning welfare improvements associated with their suggested policies; second, while A-H-D do not pretend to speak to issues related to optimum, i.e., constrained welfare maximization, policies, we comment briefly on the conditions under which a price stabilization policy would be consistent with a policy of welfare maximization.

Price Stabilization and Welfare Improvements

A-H-D conclude that "price stabilization strategies of the form examined here would appear to offer a means of making consumers better off . . . (and) producers . . . no worse off than in the current (non-declining output) strategy" (Adams, p. 671). This may well be true in a world as characterized by the A-H-D model, one wherein the discount rate is zero and the timber resource is not scarce. In the A-H-D model, there is neither a resource constraint from which scarcity values of the resource stock might be imputed, nor, strictly speaking, a terminal value relation which would impose the ramifications of post-2000 depleted resource stocks on 1978–2000 measures of welfare. The value of privately-held timber stocks at the end of the year 2000 is simply determined by the (nondiscounted) impact on costs in 2000 of terminal stocks and the fixed stumpage price in 2000. The terminal and scarcity values of the public (U.S. Forest Service) stocks—those used to stabilize prices—seem to be totally ignored.

The implications of this argument are immediately apparent. A-H-D's measures of "welfare improvements" are overstated due to (*a*) their failure to discount (or to argue that a zero discount is in some sense "appropriate"), and (*b*) their failure in some manner to account for the value of public timber stocks in the post-2000 period.

Welfare Maximization

While as mentioned above A-H-D do not pretend to view forestry management policies in terms of welfare maximization, it is interesting to consider the conditions under which their proposed policies, which require continually rising levels of output, might at least be consistent with policies designed to maximize social welfare. Social welfare is taken here to be, as A-H-D, the sum of producer and consumer surplus.

A simple model which captures the essence of the conceptual structure underlying A-H-D's approach is the following. Let $p_t(q_t)$ and $c_t(q_t)$ measure demand and supply relations for end products in period t; $\beta^t = (1 + r)^{-t}$ is the discount factor with a rate of discount r, and X_t is the timber stock at the beginning of period $t (t = 1, 2, \ldots, T)$. We assume that the timber stock increases at the rate α; i.e., $X_{t+1} = X_t(1 + \alpha) - q_t$, where q_t is the periodic harvest. (To simplify the exposition, we leave unspecified the precise nature of the transition of timber harvest to end products.) The use of X, q, and α as average measures across different aged stands is obviously heroic, but should be palatable for the qualitative results sought here. We look, then, to the problem of maximizing

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$$(1)\quad \sum_{t=1}^{T}\left[\int_0^{q_t}\{p_t(q_t) - c_t(q_t)\}dq_t\right]\beta^t + V_{T+1}(X_{T+1})\beta^{T+1},$$

where V_{T+1} is the terminal value of timber stocks, subject to the condition

$$(2)\quad X_{t+1} = X_t(1 + \alpha) - q_t.$$

With the appropriate Lagrangian for this simple problem (see, e.g., Burt and Cummings) it can be shown that optimality requires the choice of q_t in any period t such that the following condition holds for $q_t > 0$:[1]

$$(3)\quad \{p_t(q_t) - c_t(q_t)\} = \beta^{-t}(1 + \alpha)^{T-t}\frac{\partial V}{\partial X_{T+1}}\beta^{T+1}.$$

The left-hand side of (3) is the "gap" between price and cost and is denoted for any t as G_t. Since, for period $t + 1$,

$$(4a)\quad p_{t+1}(q_{t+1}) - c_{t+1}(q_{t+1}) = \beta^{-(t+1)}(1 + \alpha)^{T-(t+1)}\frac{\partial V}{\partial X_{T+1}}\beta^{T+1},$$

$$(4b) = \beta^{-t}(1 + \alpha)^{T-t}\beta^{-1}(1 + \alpha)^{-1}\frac{\partial V}{\partial X_{T+1}}\beta^{T+1},$$

it then follows, after rearranging terms, that

$$(5)\quad G_{t+1} = \frac{(1 + r)}{(1 + \alpha)}G_t.$$

From (5) it is obvious that as long as $\alpha > r$—clearly the case in the A-H-D model with $r = 0$—optimality requires increasing rates of output with nondecreasing demand and nondecreasing supply (in the schedule sense). But more to the point, with increasing demand and a cost function $c(q)$ independent of time, as assumed by A-H-D, and given that demand and supply are not both price inelastic, the imposition of the A-H-D price-fixing scheme in (5) would imply for any t,

$$(6)\quad \{p_{fixed} - c_{t+1}(q_{t+1})\} = \frac{(1 + r)}{(1 + \alpha)}\{p_{fixed} - c_t(qt)\}.$$

With prices fixed via increases in q(i.e., $q_{t+1} > qt$), then the price-fixing scheme is consistent with welfare maximization only under conditions where α is greater or equal to r.[2]

Juxtaposition of the welfare-maximizing condition (5) to the A-H-D model is useful in that it allows insight as to the curious (to the minds of these writers) conditions under which a public policy might be optimally designed to increase production rates from natural resource stocks over time with fixed prices. Such a policy seems perverse because one would intuitively expect even quasi-optimal policies to involve nonincreasing production rates from scarce resource stocks under these conditions.

Of course, as pointed out, the public stock is seemingly not scarce in the A-H-D model. If, however, the biological own rate of interest (α, in this case) exceeds the time preference rate of discount (r), increasing production rates over time are immediately anticipated. Serious questions concerning stability may be raised in this last case, however (Quirk and Smith, pp. 11–14). That such conditions would render A-H-D results consistent, in some qualitative conceptual sense, with welfare maximization policies says little in any real-world context, however. It is difficult to conceive of relevant real interest rates on the order of average growth rates in timber stocks—some 2.5% in 1970. (See report of the President's Advisory Council, p. 7, table 1-1.)

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[1] Differentiation of the Lagrange with respect to $X_t, X_{t+1}, \ldots$, yields conditions of the form $\lambda_t = (1 + \alpha)\lambda_{t+1}$, $\lambda_{t+1} = (1 + \alpha)\lambda_{t+2}$, . . .; by substitution, $\lambda_t = (1 + \alpha)^2\lambda_{t+2}$, and finally, $\lambda_t = (1 + \alpha)^{T-(t-1)}V_{T+1}\beta^{T+1}$ for any t.

[2] From a mathematical point of view, it is tempting to push the analysis to considerations involving dynamic and steady-state conditions. The extremely simplified statement of the forestry management problem used here for very limited purposes makes such extensions meaningless in any policy sense. Lying at the heart of analyses concerning stock management-related issues is the distribution of the age of forestry stands, a dimension from which we abstract in this paper.

New Health Practitioners and Rural Health Care

Richard M. Scheffler and John E. Kushman

We present and interpret evidence from a national survey of two types of new health practitioners (NHPs) with regard to their impact on the accessibility and quantity of rural physicians' services. Specifically, we address the following questions: (*a*) Are NHPs locating in or near rural areas? (*b*) Are persons from small cities and rural areas who get training as NHPs returning to those types of areas to practice? (*c*) Are the location decisions of NHPs affected by the types of medical resources in an area in a way that works for or against rural locations?

The New Health Practitioner, Concept and Programs

The term "new health practitioner" is used to indicate "a skilled person qualified by academic and practical training to provide patient service under the supervision and direction of a licensed physician who is responsible for the performance of that assistant" (Sadler, Sadler, Bliss, p. 9). It indicates a person who performs many of the tasks traditionally reserved to the physician. As early as 1972 there were more than 130 programs producing NHPs or in development to do so (Sadler, Sadler, Bliss, pp. 32–33, 176–189). The NHP was viewed as a means of easing a perceived overall doctor shortage, providing useful jobs for medical corpsmen returning from the Viet Nam war, reducing inflation in the costs of medical education and medical care, improving the quality of care, and achieving a more even geographic distribution of physicians' services (Sadler, Sadler, Bliss, pp. 13–16).

Medex programs provide training to ex-military personnel with considerable experience in patient care. Another group of programs produces "nurse practitioners" by providing nurses with additional training. The third, and most heterogeneous, set of programs produces "physicians' assistants," drawing almost entirely on persons with such previous experience as nurses, medical laboratory technicians, and therapists.

This paper deals only with Medex and physicians' assistants (PAs). This is a natural division because PAs and Medex have been viewed by themselves and others as being interdependent with physicians. Nurse practitioners, on the other hand, have tended toward independent practice (Fisher and Horowitz; Sadler, Sadler, Bliss). Medex and PA programs differ among themselves, but Medex programs are more uniformly geared to private practice of general medicine than PA programs which produce a number of assistants for hospital-oriented specialists. Medex programs more frequently require a preceptorship with a private physician, and the preceptorships tend to be with rural physicians. It is expected that Medex will find their initial jobs with their preceptors (Sadler, Sadler, Bliss, pp. 20–28; Fisher and Horowitz).

While there are valid general differences between PAs and Medex, the program categories share an overall emphasis on primary care in ambulatory settings and, especially in areas where access to physicians' services is poor because of a paucity of physicians, distance to care, racial or ethnic barriers, or limited financial means. Unfortunately, little research has been done on the extent to which NHP programs are achieving their objectives. After a review of existing research on physician extenders (PEs), Apple and Lowin concluded:

> (T)he meager evidence we have can hardly be said to offer valid testimony on the location of PE's (or even physician assistants). We are forced to the conclusion that little is known directly about the national location of PE's, except that (a) a sizable proportion of the early graduates seem to have settled in the South, (b) that they are located in at least 29 states, and (c) that they have been shown to be able to practice almost anywhere. (p. 67)

The surveys from which we draw our data were designed to provide a more complete view of NHP location patterns as well as other practice characteristics. In this paper we concentrate on the propensity of NHPs to locate in rural areas.

The Data

The data were generated by a national survey of graduates of Medex and PA programs and informally trained persons certified by the National

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Board of Medical Examiners as of the spring of 1975. Of forty-nine training programs with graduates, forty-four cooperated in the survey. A mail survey, two follow-up mail surveys, and a follow-up telephone survey were used in that order. After all surveys the response rate was 76.1%, and 1,043 usable responses were obtained. Tests for nonresponse bias suggest that the data may underrepresent the proportions of NHPs who are members of minority races, are not employed as NHPs, or work in institutional settings (Scheffler, 1977b, appendix A). Thus, our conclusions and hypothesis tests should be regarded as tentative with respect to these groups. The bias produced by the five programs not participating cannot be determined.

Although the 1975 survey is the basis for most of this paper, some data were obtained in 1976 when the respondents were resurveyed. Problems in locating respondents who had moved, the measures taken by some of the participating programs to ensure the anonymity of their graduates, and nonresponse reduced the number of questionnaires returned in 1976 to a little less than one-half of those in 1975. After a second mailing the response rate was 69.1%.

Findings

An initial view of the location of PAs and Medex is provided by table 1 which gives the percentage distributions of PAs, Medex, the U.S. population, and nonfederal physicians by county metropolitan status. Binomial tests at 1% show that Medex are found in rural locations more than PAs, but both types of practitioners are more rural than patient-care physicians. Both types of NHPs are helping to redistribute physicians' services toward rural areas, but Medex are more effective than PAs in that respect. This is consistent with the more widespread emphasis on rural primary care in Medex programs.

General practitioners are the physicians whose services can be supplemented most by NHPs, and they are the physicians most apt to be in rural areas. The distribution of Medex is significantly more rural than that of general practitioners at 1%. PAs, on the other hand, have the same propensity as GPs to be in nonmetropolitan counties. Both types of NHPs are significantly more rural than the general population.

A second way of looking at the impact of NHPs on rural health manpower is to examine the number of extenders working in counties designated as Critical Health Manpower Shortage Areas. A CHMSA is a county or part of a county that is determined to have inadequate access to medical care—especially primary care. At least parts of about one-fourth of the counties in the United States are CHMSAs and a very high proportion of these are rural (Fitzwilliams). Designation of an area as a CHMSA makes it eligible for assignment of National Health Service Corps personnel. Designation is based on the physician-to-population ratio, other medical resources in the area, and distance to the nearest source of care.

Only 6.1% of the respondents were located in a county designated as a CHMSA. This figure, however, should not be viewed as too alarming. It represents only cases where an entire county was designated, and many of the programs surveyed were located in regions where there were no whole-county CHMSAs. Second, where physicians are scarce there is little opportunity for NHPs to work.

There is some evidence that the place where a physician and his/her spouse were reared influences the choice of practice location (Cooper et al.). If the same is true for physician's assistants, selecting students from rural communities would help to ensure that more graduates practice in rural areas.

We compared the distributions of work locations with those for type of hometown. Hometowns were characterized by respondents in the 1975 survey while present locations were described in the 1976 survey. The proportion of NHPs raised in a rural area (or a town of fewer than 10,000 people) who practice in such a location is 0.43 versus 0.21 for those raised elsewhere. A binomial test shows the difference to be significant at 1%. Apparently, persons raised in a more rural environment are more likely to work in a rural environment. This test should be regarded with care because the method of

Table 1. Percentage Distribution of PAs, Medex, U.S. Population, and Nonfederal Physicians by Metropolitan Status of Counties

County Status	Percentage of Physician's Assistants[a]	Percentage of Medex[a]	Percentage of PAs and Medex[a]	Percentage of Patient-Care Physicians[b]	Percentage of General Practitioners[bc]	Percentage of Population[bd]
SMSA or potential SMSA counties	69.4	43.8	63.4	87.4	69.4	75.3
Non-SMSA counties	30.6	56.2	36.5	12.6	30.6	24.6

Note: Percentage may not add up to 100 due to rounding.

[a] Excluding missing and invalid responses.

[b] Source: Mason. Nonfederal patient-care physicians excluding those in U.S. possessions as of Dec. 1975.

[c] Nonfederal office-based physicians in general practice as of Dec. 1975 excluding those in U.S. possessions.

[d] Resident population as of 31 Dec. 1973, excluding U.S. possessions.

selecting the 1976 survey recipients does not permit the assumption of a truly random sample even from a population with fewer nonwhite and institutionally-employed NHPs than the national population. The 36.9% of the respondents who reported the two most rural hometown categories indicates the extent to which students from rural areas have been selected.

Rural areas would be disadvantaged if NHPs are most likely to find employment in types of firms that are scarce in rural areas. For instance, group practices may be able to employ NHPs more efficiently than solo practices because they have a greater load of delegable tasks. Data from an earlier survey indicates that PAs and Medex working in nonsolo practices spend more time in patient care not directly supervised by a physician. These observations are consistent with higher productivity of PAs and Medex in nonsolo practice. PAs also appear to have relatively high earnings in hospital and nonsolo settings which suggests higher productivity in those firms. Medex have no apparent earnings differential among employer types (Scheffler 1977a, pp. 786–90).

Because the employment opportunities of NHPs are conditioned by the employment of physicians, a more interesting comparison is between NHPs and patient-care physicians. The percentage of noninstitutional patient-care physicians who are in group practice was computed assuming that only physicians in office-based practice and whose principal activity is patient care report group practice. The number of physicians in groups in 1975 was taken from Bennett and the number of office-based patient-care physicians from Mason (p. 16). Because the assumptions involved in this computation cannot be confirmed, it was decided not to make statistical tests of the estimated differences. Our estimate is that 31% of patient-care physicians in noninstitutional practice are in groups. Comparing this to the 33% for Medex suggests that Medex show no important bias toward groups. The 39% for PAs seems more indicative of a pro-group bias, although the bias is not great. Thus, given the decisions of PAs and Medex to be in noninstitutional practice, it probably makes little difference for their distribution whether rural areas show relatively high incidence of group practice. Any disadvantage that rural areas have probably will yield to financial incentives for the rural employment of NHPs in the new Rural Health Clinics Act. The act provides reimbursement under Medicare and Medicaid for services of NHPs in underserved rural areas (U.S. Congress). In general, these programs do not reimburse for NHP services.

Medex and physicians appear to have about the same propensity to take institutional employment. Twenty-five percent of patient-care physicians are not in office-based practice (Mason, p. 16), while 21% of Medex are in hospitals, nursing homes, and other institutions. On the other hand, almost 43% of PAs are employed in institutions. Thus, PAs may tend to locate in urban areas because of the greater concentration of large health care institutions there. Metropolitan areas, for instance, have 4.56 hospital beds per 1,000 persons, but nonmetropolitan areas are not far behind with 4.41 (Mason, p. 17). The urban-rural contrast is probably greater for nursing homes, but they employ only about 1% of all PAs in our sample. Overall, rural areas do not appear to be substantially disadvantaged in attracting NHPs by a lack of institutional employers, although this conclusion must be tempered by an apparent minor underrepresentation of institutional NHPs in the data.

Conclusions

The evidence we have presented must be regarded as preliminary in the sense that NHPs represent a new profession. There are many questions still to be resolved, such as the extent to which physicians can legally delegate tasks to NHPs and the eligibility of NHP services for third-party reimbursement. All of the unresolved issues will have roles in shaping the future of the profession, and we cannot fully predict their influence. Our major conclusions, however, seem to be valid under alternative scenarios and to be relevant to policies shaping the profession's future.

Medex and physician's assistants are locating in or near rural areas to a greater extent than general practitioners or all physicians. These new professions should have an important impact on the distribution of physicians' services. Recruitment of persons with rural upbringing can enhance that impact. There is no evidence that rural areas are substantially hampered in attracting NHPs by a relative scarcity of group practices or institutional employers, although we have not ruled out a problem with the total number of physicians. Any disadvantage of rural areas in attracting NHPs should be eased by the Rural Health Clinics Act.

Medex show a greater tendency than PAs to go into practices that are noninstitutional, solo, and rural. For many isolated areas, small practices represent the only financially viable source of care, and it is to be hoped that lessons from the Medex experience allow the results to be duplicated so that future NHPs find small rural practices attractive.

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Cost-Benefit Analysis of Flammability Standards

Rachel Dardis, Susan Aaronson, and Ying-Nan Lin

There has been increased interest in consumer protection in recent years, particularly in the area of product safety. Deaths and injuries involving consumer products pose serious social and economic problems in the United States. It is estimated that approximately 20 million Americans are injured each year in the home as a result of accidents involving consumer products. These accidents result in 30,000 deaths; 110,000 persons are permanently disabled (National Commission on Product Safety). In response to public concern for product safety, the Consumer Product Safety Commission was established in 1973 and granted broad authority to issue and enforce safety standards over more than 10,000 products.

The necessity for product safety regulations is based on several factors. First, the consumer may be uninformed of the underlying hazard and hence may not perceive the need for protection. Second, the consumer who elects to live dangerously may also be exposing others to the same risk, e.g., a cigarette smoker who involves others in a fire. The increased interdependence of consumption which characterizes a modern industrial society means that the "right to choose" and the "right to safety" sometimes conflict. Finally, part of the cost of accidents is incurred by the taxpayer rather than by the individual. In both the second and third instances, underevaluation of potential benefits by an individual consumer may result in a less than optimum level of safety for society as a whole.

The failure of the marketplace, for the reasons mentioned above, means that corrective action is required. Such actions may include improving the performance of the marketplace, e.g., consumer information, or imposing safety regulations. The role of product safety regulations in protecting the consumer has been the subject of considerable discussion in recent years (Cornell, Noll, Weingast; Dickerson and Reed; Lowrance; Mishan; Oi; Weston). Questions have been raised concerning the cost effectiveness of safety regulations compared to other consumer protection programs such as consumer information, and the role of the consumer and producer in the consumer protection process. Weston (p. 160), while acknowledging the necessity for safety regulations, cautions that the "formulation of new standards should compare trade-offs between degrees of safety, alternative methods of achieving them, additional costs and their effect on consumer usage, and relate all of these to the potential benefits." One technique for estimating the gains and losses from consumer protection programs is cost-benefit analysis. This paper investigates the role of cost-benefit analysis in determining whether product safety regulations are in the public interest and applies such analysis to an evaluation of flammability standards for children's sleepwear, sizes 7–14.

Costs of Safety Regulations

The direct costs of safety regulation in the short-run include the losses in producer and consumer surpluses due to the imposition of a regulation. However, producer losses in the short run may be averted if (*a*) the short-run supply curve is perfectly elastic, or (*b*) the transition period between the promulgation and effective date of a standard is sufficient to permit adjustment by manufacturers so that the industry is in long-run equilibrium once the standard becomes effective. Because manufacturers may produce noncomplying products during the transition period, there is no loss in producer surplus during this time. There are no producer losses in the long run, because firms may engage in other productive endeavors. In contrast, consumer losses are incurred. Consumer losses are due to the reduction in product choice, higher price, reduced wear-life, and safety maintenance costs. Other direct costs are standard development, compliance, and enforcement costs, the latter two costs again pertaining to the time the standard becomes effective. In addition, there are indirect costs associated with a safety regulation which are more difficult to quantify (Dardis). For instance, regulation may reduce the number of firms in an industry because of the inability of some firms to establish the necessary quality control procedures. Innovation may also be discouraged if manufacturers believe that new products will be unable to meet existing safety standards or may be required to meet new standards.

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Impact of Cost Increase or Product Removal

The impact of a cost increase once the standard becomes effective is given in figure 1. It is assumed that the industry is in long-run equilibrium, i.e., the cost increase is equal to the price increase for a constant cost industry or economic profits are zero for increasing or decreasing cost industries. The market demand curve and price prior to the imposition of a standard are given by D and P_1, respectively. The market price once the standard becomes effective is given by P_2, resulting in a loss in consumer surplus equal to P_1P_2ba. There is no loss in producer surplus.

The removal of existing products because of safety regulations may be caused by product banning or the inability of existing products to comply with the proposed safety standard. The loss to the consumer is given in figure 1. Consumer surplus from the consumption of Q_1 units for a market price P_1 is equal to P_1P_3a, and this area also represents the loss in consumer surplus when the product is no longer offered for sale. There is no loss in producer surplus if it is assumed that the time period between the promulgation and effective date of the standard is sufficient for firms to engage in other productive endeavors.

Other Costs

The remaining direct costs of a safety regulation are the costs of standard development and compliance. Standard development costs should be amortized over the expected life of the standard and include the time costs of money, e.g., a standard which costs $1 million to develop and has an expected life of ten years has an annual cost far higher than $100,000 a year. The solution is to estimate the revenue stream for a given discount rate which has a present value of $1 million.

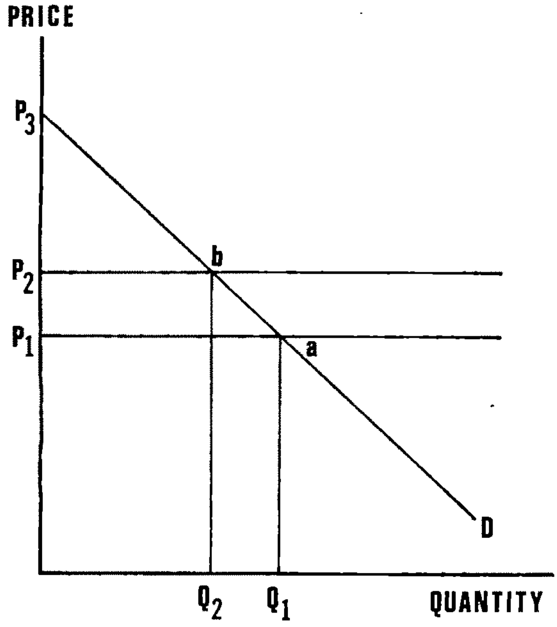

Figure 1. Cost of product regulation

Benefits from Safety Regulations

There are two major methods for estimating the benefits from safety regulations (Dardis, Linerooth, Mishan, Rice, and Zeckhauser). The first method, value of a livelihood, focuses on the direct and indirect costs of accidents to society and estimates the benefits to society from a reduction in accidents. The second method, willingness to pay, focuses on the consumer's willingness to pay for risk reduction.

The direct costs of accidents include property damage, medical costs, legal and administrative costs, and accident investigation costs. The indirect costs are the output losses resulting from accidents and the pain and suffering incurred by the victim and his family. Output is generally measured by the mean wage earnings of members of the labor force. In the case of death or permanent disability, output is measured by the present value of future earnings.

The willingness-to-pay approach avoids some of the measurement problems associated with the value-of-livelihood approach. It investigates how much the individual is willing to pay for risk reduction or, alternatively, how much compensation the individual requires for an increase in risk. While this approach has merit because it leaves the value of life and, hence, of risk reduction to the individual, it also may result in an underestimation of benefits if externalities exist or if the consumer is protected from some of the consequences of his actions, e.g., subsidized medical care. Consumer ignorance of product hazards and the belief that accidents only happen to others will also result in an underestimation of the expected loss and hence of the potential benefits. The risk assessment requirements, when only small changes in small probabilities are involved, pose further methodological problems (Dardis).

Cost-Benefit Analysis of 7–14 Children's Sleepwear Standard

The children's sleepwear standard, promulgated in 1974, became effective in 1975. Since sleepwear is a nondurable product with a life of approximately one year, costs and benefits were *compared* for one year only. While costs and benefits will vary over time depending on the population at risk, the ratio of costs and benefits should remain relatively constant because each purchase of a flame-retardant (FR) garment entails both a cost and a benefit. Estimation of costs depends on the existence of long-run equilibrium conditions in 1975. If the price increase at that time had been inadequate to cover production costs, firm exit would have occurred, resulting in further price increases in 1976 and 1977 (Ferguson and Gould, p. 296). However, an examination of price changes in 1976 and 1977 indicated that no further price increases occurred other than those caused by inflation in general, i.e., a situation of long-run equilibrium existed in 1975. This result was not surprising because there was one year between the promulgation and effective date of the 7–14 standard; moreover, the 0-6X children's sleepwear standard (which was similar to the 7–14 standard in many respects) had been in effect since 1973. Thus, once the standard became effective, only manufacturers who could comply with the standard and cover production costs remained in operation. The existence of long-run equilibrium meant that only the long-run loss in consumer surplus and standard development and compliance/enforcement costs were estimated.

The benefits from the standard were based on the estimated number of sleepwear burn deaths and injuries that would have occurred in 1975 in the absence of the standard and the associated direct and indirect costs.

Costs of Standard

The loss in consumer surplus included both the reduction in product choice caused by the displacement of cotton and higher prices in the marketplace for FR treated garments. The loss from product removal is equal to $\frac{1}{2}\Delta Q \Delta P$ or P_1P_3a in figure 1. Assuming a linear demand curve, the above expression simplifies to $\frac{1}{2}P_1Q_1/n_1$, where P_1, Q_1 is market price and quantity prior to the imposition of a standard, and n_1 is the point price elasticity of demand at P_1Q_1. The loss from a price increase is given by $\Delta PQ_1 - \frac{1}{2}\Delta P \Delta Q$ or P_1P_2ba in figure 1. Assuming a linear demand curve, the above expression simplifies to $tP_1Q_1 - \frac{1}{2}t^2n_1P_1Q_1$, where t is $\Delta P/P_1$, and the other terms are as defined earlier.

Consultation with a representative from the National Cotton Council indicated that cotton's market share declined from 62% prior to the promulgation of the standard to 16% in 1975. It was concluded, therefore, that 46% of the market incurred a major quality change because the performance of cotton products differed from the performance of synthetic fiber products. The remaining 54% of the market was unchanged with respect to performance characteristics (other than flammability characteristics) though price changes had occurred.

A survey of the fall/winter catalogs from Sears, Roebuck and Company, J. C. Penney, and Montgomery Ward was conducted for the years preceding and following the standard to determine the impact of the standard on price. These retailers were selected because they were major sellers of children's sleepwear and have a national distribution. Prices for non-FR sleepwear were inflated to 1975, using the consumer price index. Estimated 1975 non-FR prices were compared to actual 1975 FR prices to determine the percentage change in price as a result of the standard. Based on the results of the survey and consultation with industry and retail representatives, it was concluded that the 7–14 sleepwear standard resulted in a 40% price increase in 1975.

The remaining variables required for the estimation of the loss in consumer surplus were 1975 non-FR sleepwear expenditures and the price elasticity of demand for sleepwear. Sleepwear expenditures for sizes 7–14 from the 1960–61 Bureau of Labor Statistics' Consumer Expenditure Survey were updated to 1975, using the consumer price index and the change in per capita consumption of children's sleepwear from 1960–61. Total non-FR sleepwear expenditures in 1975, based on 1975 population data, were $201.60 million.

Two price elasticities of demand were used, 0.5 and 1.0. The upper estimate was based on consultation with retailers which indicated that sales had been maintained in spite of a reduction in quantity. In addition, an analysis of demand for children's sleepwear yielded elasticities of 1.17 and 1.26 (Dardis). The lower elasticity value of 0.5 was used to examine the impact of this parameter on costs and cost-benefit ratios.

Standard development costs were estimated in the neighborhood of $600,000 by officials in National Bureau of Standards (NBS) and Consumer Product Safety Commission (CPSC). This initial cost is equivalent to an annualized cost of $0.078 and $0.098 million for discount rates of 5% and 10% respectively, assuming that the standard will remain technologically practicable for ten years. An intermediate value of $0.09 million was used. Compliance and enforcement costs were the estimated marginal costs of such activities to the CPSC from the imposition of the sleepwear standard (U.S. CPSC 1973). The costs of the standard are given in table 1. The cost of product removal ranges from $46.37 million to $92.74 million for price elasticities of demand of 1.0 and 0.5, respectively. The corresponding costs for a price increase are $34.84 million and $39.19 million. Total costs range from $81.50 million to $132.22 million, with compliance and standard development costs accounting for only $0.29 million.

Table 1. Cost of 7–14 Children's Sleepwear Standard in 1975

Cost	Price Elasticity of Demand 0.5	Price Elasticity of Demand 1.0
	($ million)	
Cost due to product removal	92.74	46.37
Cost due to price increase	39.19	34.84
Compliance costs	0.20	0.20
Standard development costs[a]	0.09	0.09
Total costs	132.22	81.50

[a] Assuming standard remains in effect for ten years.

Costs of Sleepwear Burn Deaths and Injuries

The costs of burn deaths were based on the number of burn deaths and the direct and indirect costs of such deaths. The number of fire and flame burn deaths in 1975 was estimated from data provided by the National Center for Health Statistics (NCHS). Fire and flame burn death rates for years prior to the promulgation of the standard were applied to 1975 population data to yield estimates for the number of fire and flame burn deaths that would have occurred in 1975 in the absence of the standard. The number of sleepwear burn deaths was obtained by multiplying the estimated number of fire and flame burn deaths by the percentage of fire and flame burn deaths involving clothing and the percentage of clothing burn deaths involving sleepwear. Information concerning the involvement of clothing in burn deaths was obtained from several sources and ranged from 8.2% to 20% (Juillerat, National Fire Protection Association, HEW-NCHS). A range of 10% to 20% was selected to avoid possible underestimation of benefits. Information concerning sleepwear involvement in clothing burn deaths was also obtained from various sources and ranged from 22% to 41.3% (Nat'l. Fire Prot. Ass.; HEW 1970, 1971, 1972; HEW-NCHS). A range of 20%–40% was selected. It was concluded that there would have been from eight to thirty-four fire and flame burn deaths involving sleepwear in 1975 in the absence of a standard.

Labor force aggregate earnings for males and females and housekeeping aggregate earnings for females were estimated in accordance with the procedures used by Rice. However, the market cost approach was used to estimate the value of housekeeping services as opposed to the replacement cost approach used by Rice, in order to avoid underestimation of indirect costs. The market cost approach was based on services performed by the housekeeper and market price for such services (Dardis; Gauger and Walker). Costs of sleepwear burn deaths ranged from $0.82 million to $3.58 million for a 5% discount rate and from $0.28 million to $1.23 million for a 10% discount rate.

The direct costs of burn deaths were based on the number of deaths occurring in hospitals, the number of days hospitalized before death, and the cost of hospitalization per day. Weighted length of hospitalization for burn victims expiring in hospital was estimated at seventeen days. Average cost per hospital day was $292 in 1975, resulting in hospital costs per burn death of $4,964. Medical costs per burn death were $8,559, assuming hospital costs were equal to 58% of medical costs (Rice, HEW 1976). Data from flammable fabrics investigations indicated that 73% of all burn deaths occurred in hospitals (U.S. CPSC, 1973, 1974). It was concluded that from six to twenty-five burn victims would have expired in hospitals. Total medical costs for burn deaths ranged from $51 thousand to $214 thousand.

The indirect costs of burn injuries were not estimated because it was assumed that children aged 6–12 would have recovered from their burn injuries by the time they were ready to enter the work force. This assumption may have resulted in an underestimation of benefits.

The direct costs of burn injuries were based on the number of sleepwear burn injuries and the associated medical costs. The number of hospitalized burn injuries for ages 6–12 was based on the number of hospitalized burn injuries for all ages (60,000) and the proportion of hospital discharges accounted for by the 6–12 age group (11%). This resulted in an estimated 6,600 hospitalized burn injuries. The number of burn injuries due to sleepwear was based on (*a*) the percentage of burn injuries due to fire and flame–66%, (*b*) the percentage of fire and flame burns involving fabric—86%, (*c*) the percentage of fabric burns involving clothing–94%, and (*d*) the percentage of clothing burns involving sleepwear—44% (Feller, NBS). It was estimated that a total of 1,600 hospitalized burn injuries would have occurred in 1975 in the absence of a sleepwear standard.

Information concerning burn severity of injuries involving clothing and sleepwear for children aged 6–12 was also obtained from NBS. The number of hospitalized sleepwear burn victims ranged from 680 with a 0–10% body surface area burn to 48 with a body surface area burn greater than 61%. Total hospital costs were $30.51 million. In addition to those patients admitted to the hospital for burn treatment, others sustained injuries that did not require hospitalization. Based on data from the CPSC (1974), it was assumed that 592 outpatients would have been treated in 1975, in the absence of a standard. Assuming an average cost per hospital visit of $28.00, outpatient treatment costs were approximately $0.01 million in 1975. Total hospital costs for inpatients and outpatients were $30.53 million, while total medical costs were $52.64 million.

Benefits from Standard

The costs of sleepwear burn injuries and deaths and the degree of protection provided by the standard were used to estimate the benefits from the standard. Data indicated that the standard had been effective in preventing deaths and serious burn injuries. Less information was available concerning minor burn injuries (0–10% body surface area burn). Accordingly, two assumptions were made concerning the degree of protection provided by the standard. In the first instance, it was assumed that the standard would provide complete protection for all burn injury categories. The costs of burn incidents were thus identical to the benefits from the standard. In the second instance, it was assumed that the standard would provide complete protection for all categories with the exception of the 0–10% body surface area burn category where 50% protection was used. The benefits from reducing

Table 2. Benefits from 7–14 Children's Sleepwear Standard in 1975 (in Millions of Dollars)

Estimate[a]	Degree of Protection	Discount Rate (%)	Injuries Direct Costs	Deaths Direct Costs	Deaths Indirect Costs	Total Benefits
Low	Moderate	5	47.17	0.05	0.82	48.04
		10	47.17	0.05	0.28	47.50
	High	5	52.64	0.05	0.82	53.51
		10	52.64	0.05	0.28	52.97
High	Moderate	5	47.17	0.21	3.58	50.96
		10	47.17	0.21	1.23	48.61
	High	5	52.64	0.21	3.58	56.43
		10	52.64	0.21	1.23	54.08

[a] Pertains to low and high estimates of the number of burn deaths.

burn injuries thus declined from $52.64 million to $47.17 million.

The distribution of benefits is given in table 2. Benefits ranged from $47.50 million to $53.51 million, based on a low estimate of the number of burn deaths, and from $48.61 million to $56.43 million, based on a high estimate of the number of burn deaths. The major portion of the benefits are accounted for by the direct costs of burn injuries. Pain and suffering costs are not included. However, the potential benefits may be increased to take such costs into consideration.

Cost-Benefit Ratios for 7–14 Children's Sleepwear Standard

Cost-benefit ratios are given in table 3. Ratios range from 1.44 to 2.75 for a 5% discount rate and from 1.51 to 2.78 for a 10% discount rate. The discount rate has little impact on the cost-benefit ratios reflecting the low number of deaths relative to injuries. The price elasticity of demand has the greatest impact on cost-benefit ratios. Cost-benefit ratios increase by 65% when the price elasticity of demand is halved. In contrast, cost-benefit ratios increase by only 11% and 6% when the degree of protection and the number of burn deaths is reduced.

While the results indicate the importance of demand conditions in determining the impact of a safety standard, it must be remembered that price elasticities of 0.5 were used for illustrative purposes only. Cost-benefit ratios, based on unitary elasticity of demand, range from 1.44 to 1.70 for a 5% discount rate and from 1.51 to 1.72 for a 10% discount rate. The range of values is relatively close, and the ratios could be considered favorable in view of the omission of pain and suffering costs in the estimation of benefits. It might be concluded, therefore, that the 7–14 children's sleepwear standard was cost effective in spite of the reduction in consumer choice.

Discussion

The results indicate the feasibility of applying cost-benefit analysis to an evaluation of safety regulations. Limitations of the study include the omission of the indirect costs of the standard and the neglect of pain and suffering in the measurements of benefits. However, as was pointed out earlier, the permissible cost-benefit ratios may be increased to reflect the underestimation of benefits. It should also be emphasized that cost-benefit analysis is an input in the decision process. It is designed to aid the decision maker, not replace the decision maker. Thus, in the case of safety regulations, the Con-

Table 3. Cost-Benefit Ratios for 7–14 Children's Sleepwear Standard in 1975

Estimate[a]	Degree of Protection	Price Elasticity of Demand	Discount Rate 5%	Discount Rate 10%
Low	Moderate	0.5	2.75	2.78
		1.0	1.70	1.72
	High	0.5	2.47	2.50
		1.0	1.52	1.54
High	Moderate	0.5	2.59	2.72
		1.0	1.60	1.68
	High	0.5	2.34	2.44
		1.0	1.44	1.51

[a] Pertains to low and high estimates of the number of burn deaths.

sumer Product Safety Commission may consider (and has considered) other factors in determining its course of action. However, cost-benefit analysis can make a major contribution when several programs or standards for several products are under consideration. Under such circumstances, a comparison of cost-benefit ratios should assist the decision maker in selecting the most cost effective consumer protection programs. Finally, the analysis discussed in this paper may be applied to a variety of existing or proposed regulations affecting the consumer. The major costs in all instances are likely to be increased market prices or the reduction in consumer choice, while the benefits from regulation are the improvements in health or safety of the consumer. Examples in the food and fiber sectors include the use of chemicals in food or fiber production and processing. The passage of the Toxic Substances Control Act and the formation of an interagency task force by the CPSC, FDA, EPA, and OSHA suggest that the health and safety of the consumer will remain of primary concern in the future. Cost-benefit analysis may play an important role in determining whether proposed health and safety regulations are in the public interest.

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A Critique of the Use of BLS Data for Market Structure-Price Analysis

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Food prices, and the factors affecting them, are subject to continuing examination by academicians and policy makers. As in most areas of economics, analysis is dependent on the available data. The Bureau of Labor Statistics (BLS) provides in *Estimated Retail Food Prices by City* the only publicly available and ongoing data set on retail food prices. These data are widely used (and misused) in economic analysis. A recent study (Grinnell, Crawford, Feaster) that used the BLS data received considerable attention at hearings on prices and profits in food retailing conducted in the spring of 1977 by the Joint Economic Committee. Ignoring disclaimers by the study's authors, industry representatives cited the study as evidence that market concentration and retail food prices are unrelated and once again aroused interest in the validity of using BLS price data for cross-sectional market structure-market price analysis.[1]

It should be noted at the outset that BLS price data were never intended to answer the questions of industrial organization economists. BLS price data for food consumed at home attempt to reflect the average food costs of consumers in different metropolitan areas and the nation. Differences among city average prices may be due to differences in competitive environments, the products consumed, or the size and type of stores. All are possible causes. Determining the extent to which price differences are due to the different factors, a primary concern of industrial organization economists, is impossible with present BLS data.

In examining the performance of markets, both operational efficiency (i.e., cost per unit of output) and allocative efficiency (i.e., the equivalence of prices and costs) are important and rather traditional dimensions of performance considered. Available data indicate that operational efficiency in supermarkets is much greater than in convenience and specialty stores. For entire markets, the greater the importance of supermarkets, the lower the expected cost of the retailing function.

Analysis of allocative efficiency in retail food markets is particularly concerned about questions such as (*a*) Does Safeway, A&P, or other supermarket chains charge lower (higher) prices in their stores in competitively structured markets than in noncompetitively structured markets? (*b*) Are average supermarket prices in competitively structured markets lower (higher) than in noncompetitively structured markets? Data to examine these questions are generally not available. This note considers the relevance of BLS price data for such analyses. That is, if store size and type is held approximately constant by examining only supermarkets, how are food prices affected by market concentration, barriers to entry, product (or enterprise) differentiation, and differences in factor costs?

When used as an indicator of allocative efficiency across markets, BLS data have two major shortcomings. This paper discusses the nature and implications of these shortcomings, but is not written as a criticism of BLS, because this agency has emphasized that its price data are collected for comparison of prices over time, not across markets (Rothwell).

In developing retail food price data, BLS follows two procedures which would be expected to lead to an inverse relationship between market concentration and BLS market average prices. Briefly these are: (*a*) The brand of individual products selected for pricing is based upon volume and, hence, is allowed to vary from store to store and from market to market. The lack of comparability that results is particularly serious when private label products are selected in some cases and national brand in others. Lower priced private label products tend to be included more frequently in BLS calculations in concentrated than in unconcentrated markets. (*b*) BLS market average prices reflect the prices of all types of food stores in a market, weighted approximately in accord with their market share. However, if allocative efficiency is the performance dimension of interest, it is inappropriate to combine the prices of different types of stores into a market average. Because supermarkets represented 67% of all food store sales and 72% of all grocery store sales in 1972 and tend to set the competitive tone in most

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[1] An additional BLS data set, the Urban Intermediate Food Budget, was introduced at the recent Joint Economic Committee hearings by food chain spokesmen as evidence that prices in local markets are not correlated with market concentration. The method of calculation has similar brand and outlet biases as BLS food price data and is plagued by additional limitations as well (Sherwood). All in all, the food budget data are as objectionable for use in market structure-price analysis as the currently published BLS food prices.

markets, we contend that the supermarket submarket is the relevant market in which to examine allocative efficiency. The inclusion of higher priced small stores tends to make BLS prices higher in unconcentrated markets than in concentrated markets.

Before discussing more fully these sources of bias for allocative efficiency studies and illustrating their significance, a brief summary of BLS calculation procedures may provide a useful foundation.

BLS Estimation Procedures

Rothwell provided a succinct summary of the basic procedures followed in the development of index values, benchmark prices, and reported market average food prices, including the sampling, weighting, and aggregation procedures used in estimating retail food prices. This description draws heavily on this and other publications authored by representatives of the Bureau of Labor Statistics (Hoover and Stotz, USDL Bull. Nos. 1517, 1632, 1711, 1964–8).

The BLS market average prices are developed from prices collected for the computation of the food-at-home component of the Consumer Price Index. Products priced are specified within a narrow size and quality range. However, products included within the market basket are not prespecified with respect to brand. The particular brand of product priced in each store is selected based upon the volume sold in that outlet. Thus, in one store a private label concentrated orange juice may be selected while in another a national brand of concentrated orange juice may be chosen. Given this selection procedure, the brands priced may vary from outlet to outlet within a market as well as from market to market. After initial sampling in each outlet, the same items are sampled from one period to the next unless they are either discontinued at the outlet or another item meeting specifications outsells the initially selected item by a ratio of 2 to 1 over an extended period of time.

Outlets sampled in each market are partitioned into three strata of stores: chain food stores (four or more stores under common ownership accounting for at least 1% of market sales), large independent food stores (annual sales of $500,000 or more), and small independent food stores ($50,000 to $500,000 annual sales). The average chain price for individual products is calculated using each chain's share of total food chain sales in the city as weights. The average price of a product in large, independent stores and in small, independent stores is calculated as a simple or unweighted mean. The overall city average price for a product is computed by weighting the average price in each category of stores (i.e., chains, large independents, and small independents) by commodity weights. Commodity weights are simply the proportion of meat, produce, and dry grocery sales in the market accounted for by each class of outlets. The weighted average market prices for ninety-four products are reported individually on a monthly basis by BLS for twenty-four individual SMSAs. They are also aggregated using expenditure and population weights and combined with nonpublished data for thirty-two small cities to develop a price index for food consumed at home in the United States. For individual markets, BLS does not compute a price index for a market basket of products. Average prices developed using "benchmark prices" are reported only for individual products. These must be weighted by expenditure weights and aggregated to develop estimated prices for the BLS market basket.

As noted, BLS prices are collected to measure period-to-period price changes for particular markets and for the nation, not for price comparisons across markets. For price change measurement, across-market variability in the size, quality, and brand of items selected is not a major concern. However, each of these factors places strong limitations on the data for market structure-price analysis.

Bias Due to Brand Selection Procedures

Selecting the brand of a product to be priced in individual stores based upon the volume sold provides neither an accurate estimate of the average price for all brands of that product nor for a standardized brand (e.g., Maxwell House regular coffee) that can be compared easily across stores or markets. This problem is accentuated in those cases where private label products sell in greatest volume and are selected for pricing. This problem was noted in the National Commission on Food Marketing (Tech. Study No. 7, pp. 310–11).

The impact of selecting private label items on the estimated market basket average price will vary according to the price differences between national brand and private label items and the total weight given the private label prices in calculating average product prices. The National Commission on Food Marketing found that for ten products examined in 1965, leading advertised brands were, on average, priced 21.5% higher than grocery products carried under private label (Tech. Study No. 10). A recent study of about fifty items found national brand grocery products were 12% higher in price than comparable private label products (Marion et al.). A 1975 Cornell study had similar results—13% difference (Cooperative Extension).

The extent to which private labels are selected in the BLS sampling procedure is not known. However, it is clear that private label products have been and remain important with respect to sales and tonnage volume, particularly in large chains. The National Commission on Food Marketing found that for large chain retailers with sales greater than $250 million, an estimated 20% of total grocery product sales (excluding nonfoods) was attributed to private label brands whereas only 13.2% and 9.5% of total grocery sales were attributed to private label items for medium and small retailers, respectively (Tech. Study No. 10).

Through a hypothetical example, the possible bias inherent in the price calculation procedure can be illustrated. Volume movement and prices for four product brands are provided in table 1 for two stores. The BLS-selected prices in this illustration would indicate that outlet B had prices 14.3% higher than outlet A, whereas the actual difference was only 1.3%.

This example can be extended from one product group (green peas) to the entire store. If the distribution of sales in outlet A is more typical of supermarket chains and that in outlet B more typical of independents, then BLS selection procedures would result in BLS chain prices being lower than the actual average prices; the reverse would be true for independents. Since chain and independent prices are weighted by their respective market shares in estimating BLS market average prices, the magnitude of the illustrated error would be expected to be closely related to the share of market held by grocery chains. In concentrated markets where grocery chains tend to be relatively more important, the magnitude of this error would be greater than in unconcentrated markets. This may result in BLS market average prices being inversely related to the level of market concentration when in fact there is a positive relationship.

Either the weighted average price for a product or the price of a specified brand would be more suitable for cross-sectional analysis of allocative efficiency. The former would substantially increase data collection and computation procedures but would capture variations in the price relationships of different brands across stores or markets. Pricing a specified brand (Heinz Catsup) in all stores is the simplest way of assuring comparability, but ignores variations in the relative price of competing brands. Although we are inclined to prefer the second approach, either of these selection procedures are strongly preferred to the current BLS procedures.

Bias Due to Outlet Selection and Weighting

Market structure-price analyses are highly dependent on accurately defining "relevant markets" for examination. Ultimately, defining relevant markets depends upon the extent to which buyers perceive alternative firms or products as substitutes. Firms with significantly different product-service-price offerings may be considered as relatively poor substitutes and therefore not in the same "market."

In calculating market average prices for food consumed at home, BLS is concerned about the average price paid by consumers for food from all outlets, whether or not they are direct competitors. Supermarkets, convenience stores, meat markets, produce markets, and small corner grocery stores are all included in the population from which BLS selects outlets to be price checked.

While the BLS procedure may provide reasonable estimates of the change over time in the amount that consumers spend for a market basket of food in a given area, it is not appropriate for market structure-price studies examining allocative efficiency. Supermarkets, small grocery stores, meat and produce markets, and convenience stores offer rather distinct combinations of products, services, and prices. For example, studies by *Progressive Grocer* indicate that convenience stores generally do not carry fresh produce or meat and derive nearly 60% of their sales from six product categories—tobacco, beer, soft drinks, milk, magazines and newspapers, and candy (1976). The same categories represent only 15% of the typical supermarket's sales. The value of the average transaction in supermarkets is about five times that in convenience stores. Gross margins are approximately 50% higher in convenience stores than in supermarkets, or 28.5% vs. 19.3% (1977, pp. 151, 189). These differences suggest that the cross elasticity of demand between supermarkets and convenience stores is low and that these stores operate in separate submarkets. Combining the prices or costs of different types of retail food outlets into a

Table 1. Hypothetical Example of the Effects of BLS Item Selection Procedure

	Outlet A		Outlet B	
Brand of Green Peas	Percentage of Green Pea Volume	Price ($)	Percentage of Green Pea Volume	Price ($)
Green Giant	25	.42	25	.42
Del Monte	25	.40	25	.40
Libby	20	.40	30	.40
Private label	30	.35	20	.35
Weighted average price		.39		.395
BLS price (highest volume item)		.35		.40
Difference		−.04 (−10.3%)		+.005 (1.3%)

"market" average prevents any meaningful analysis of either operational or allocative efficiency.

In terms of their effects on consumer food prices, supermarkets are easily the most important submarket in food retailing to examine in market structure-price studies. Unfortunately, supermarket average price data are not available. The use of BLS price data as a surrogate introduces an important bias. This bias is illustrated in table 2 which was constructed using the relative price levels for different outlet types reported in the NCFM study (1964–65 data) and the weights used for meat, produce, and grocery by BLS for chains, large independents, and small independents. Market and grocery basket costs were calculated for Washington, D.C., Houston, Texas, and six cities studied in the NCFM report, assuming equal price levels for the same outlet type across markets. The differences in market basket costs shown in table 2 are attributable to differences in consumer purchasing patterns between outlet types and not due to differences in outlet prices across markets. The grocery and market basket costs for Washington, D.C., a chain and supermarket dominated market, are 1.7% and 0.7% lower than in Houston where independents accounted for 56.0% of market sales. Comparison of the 1967 four-firm concentration ratios and market average prices indicates an inverse relationship between the two variables. Using these data it might be argued, contrary to theory, that increasing levels of concentration result in lower average market prices. When all food retail outlets in metropolitan areas are included in the calculation this may be true simply because of the greater importance of supermarkets in some areas. The average consumer may pay less (though not as much less as BLS data suggest) for a market basket of food in concentrated markets because he buys a larger portion of his food from supermarkets than in unconcentrated markets.

Conclusion

Given these two important biases in the BLS food price data, attempts to examine the market structure-price relationship among metropolitan areas using these data are likely to result in spurious relationships. Because of the item and outlet selection and weighting procedures, BLS food price data are expected to be biased toward a negative relationship with market concentration. Unless these biases are taken into account either through model specification or by correcting the data directly to reduce or eliminate these biases, they are likely to mask or confound the true market structure-price relationships which exist.

Adjustments in BLS sampling and reporting procedures could make the data much more useful for market structure-price analysis. For example, published average price data could be stratified by type of retailer (supermarket chains, large independents, small independents, and convenience stores) and by retail department (grocery, meat, and produce). All of the necessary data are presently developed and used by BLS. Computational and reporting changes would appear to be relatively simple to make. Such a change would make it possible to avoid the outlet bias in BLS average prices discussed above. This would not eliminate the problem of pricing different brands of products in different stores and different markets. However, this source of bias should also be reduced if a researcher examined chain prices across markets. These modifications in BLS reporting procedures would convert a data set that is presently of little value for market structure-price analysis into one of considerable value.

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Table 2. Market Basket Costs in Three Case Situations in Which Chains and Independents Vary in Importance

Market	All Chains' Share of Food Store Sales[b]	Four Largest Chains' Share of Food Store Sales (CR4) 1967	Index of Grocery Basket Cost[c]	Index of Market Basket Cost[c]
Washington, D.C.	80.3%	70.3%	100.9	100.3
Six city average[a]	61.0	48.8	101.8	100.6
Houston, Tx.	44.0	32.2	102.6	101.0

[a] The "six city average" is comprised of those six markets studied by the National Commission on Food Marketing (NCFM Tech. Stud. No. 7, p. 308).

[b] Calculated by multiplying the percentage of meat, produce, and grocery sales accounted for by chains in each market, as reported by BLS, times the proportion of food store sales represented by meat, produce, and grocery products, as reported by the National Commission on Food Marketing (Miller, p. 58, NCFM Tech. Stud. No. 7, p. 309).

[c] Grocery basket and market basket costs were calculated using the price indexes developed by the Food Commission for chains, large independents, and small independents for various product categories (Tech. Stud. No. 7, p. 309). These were weighted by the percentage of food store sales accounted for by these product categories (NCFM, Tech. Stud. No. 7, p. 319), and then by the percentage of total market sales made by each type of outlet (chain, large independent, and small independent) in the above markets as reported by BLS (Miller, p. 58).

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U.S. Agricultural Production Capacity: Reply

Luther Tweeten, Leroy Quance, and Chung Yeh

This "Reply" addresses several points raised by Pierre Crosson in his comment on the article "U.S. Agricultural Production Capacity" by Yeh, Tweeten, and Quance. His major points are summarized as follows: (*a*) U.S. agricultural production capacity is likely to be challenged by 1985. (*b*) Given that demand is increasing faster than supply, the real price of agricultural commodities should rise rather than fall. (*c*) The conceptual model underlying the impact of inflation on the farming industry is not clearly presented in the article. (*d*) The production projections for 1985 are not consistent with the export and domestic demand components. (*e*) Does supply become less elastic at price ratios less than or greater than 180?

Will Agricultural Production Capacity be Challenged?

Whether agricultural production capacity will be challenged is in part a question of semantics, as Crosson recognizes. We consider capacity to be challenged if the demand curve (including concessional sales or grants at home and abroad) intersects supply near the feasible supply capacity. Under each scenario considered, unutilized production capacity is at least 50% more than expected equilibrium production. In three of five scenarios considered, including the baseline scenario, the real supply price of farm output falls below the 1974 price by 1985. Because farm input prices move in a pattern similar to national inflation, the falling real price (ratio of prices paid to prices received by farmers) suggests that the real price of food at the farm level is likely to be lower in 1985 than in 1974. In the case of the high demand scenario, real price increases 0.2% per year and in the unrealistic case of low technology real price is projected to increase 0.5% per year. Per capita consumer real income is expected to increase at least 1.9% annually. Since we project only modest increases in per capita food consumption, consumers will spend a smaller percentage of their income on farm supplied ingredients of food in 1985 than in 1974. That equilibrium output grows somewhat lethargically in relation to demand might be taken as a sign of stubborn resistance of the agricultural plant to provide needed output. Such seemingly "challenged capacity" is the product of inflation rather than sharply diminishing physical returns.

Falling Real Prices with Excess Demand

Many issues raised by Crosson fall into place when we explain why real farm prices fall in the face of demand increasing substantially faster than supply. As stated in the article, supply shifts at the rate $\phi - \lambda\theta$, where ϕ is the rate of increase in productivity, λ is the elasticity of supply, and θ is the rate of input price inflation. In the baseline case, $\phi = .0114$, $\lambda = .2$ (short run) to 1.0 (long run), and $\theta = .04$. Hence supply increases 0.34% per year in the short run and -2.86% per year in the long run. With demand increasing at a rate of $\gamma = .015$ or 1.5% per year, it is clear that demand considerably outpaces supply. Consequently, nominal product price increases sharply as apparent in table 2 of our article. But why the drop in real farm prices defined as the ratio of prices received to prices paid by farmers. Using the above parameter notation along with price elasticity of demand β, the model, omitting lags, is

$$(1) \qquad Q_t = \alpha P_t^{\beta} e^{\gamma t} \text{ (Demand), and}$$

$$(2) \qquad Q_t = \delta (P_t/P_o e^{\theta t})^{\lambda} e^{\phi t} \text{ (Supply),}$$

where Q is quantity, P is product price, P_o is input price in the base year, and α and δ are constants. Given equilibrium between demand and supply, (1) and (2) may be equated and solved for P_t:

$$(3) \qquad P_t = [(\delta/\alpha)\, P_o^{-\lambda}]^{\frac{1}{\beta - \lambda}}\, e^{\left(\frac{\phi - \gamma - \lambda\theta}{\beta - \lambda}\right)t}.$$

The change of nominal product price P_t with time is

$$(4) \qquad \frac{dP_t}{dt} = [(\delta/\alpha)\, P_o^{-\lambda}]^{\frac{1}{\beta - \lambda}} \left(\frac{\phi - \gamma - \lambda\theta}{\beta - \lambda}\right) e^{\left(\frac{\phi - \gamma - \lambda\theta}{\beta - \lambda}\right)t}.$$

Dividing (4) by (3), it is apparent that the rate of increase in P is $r = (\phi - \gamma - \lambda\theta)/(\beta - \lambda)$.

The impact of lagged values is considered by using short- and long-run coefficients in r from the baseline case as follows:

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Journal Article 3441 of the Agricultural Experiment Station, Oklahoma State University, Stillwater.

	Short run	Long run
β	−.1500	−.2100
λ	.2000	1.0000
γ	.0150	.0150
ϕ	.0114	.0114
θ	.0400	.0400

From these values, r is .0331 in the short run and .0360 in the long run. Again using the baseline scenario, the projected annual rate of decline in real price is $\theta - r$ or 0.69% in the short run and 0.40% in the long run.

The actual average annual rate of decrease in real price was 0.5% for the baseline scenario in table 2 which falls within the range of .40 to .69 predicted from equation (4) above. Thus real price falls even as demand increases considerably faster than supply.

It is possible to generalize somewhat. Real price will fall if $r > \theta$, i.e., if $\phi > \beta\theta + \gamma$. For the short run, with $\beta = -.15, \theta = .04$, and $\gamma = .015$, real price will fall if the rate of increase in supply due to productivity $\phi > .009$. In the long run, with $\beta = -.21, \theta = .04$ and $\gamma = .015$, real price will fall if $\phi > .007$. Because supply increased more than 0.9% per year in the short run and 0.7% per year in the long run due to productivity in the baseline case, real price declines.

Impact of Inflation

We agree with Crosson that a more detailed discussion of the theoretical underpinnings of inflation as it applies to the agricultural economy would have been useful. Unfortunately, space limitations intervened. We urge readers to study the theoretical and empirical research cited in the article as well as the unabridged version by Tweeten and Griffin on this vital subject.

Equilibrium Production in 1985

Crosson is justified in questioning whether our projected equilibrium output for 1985 is sufficient to sustain reasonable growth in demand.

In developing the recursive supply-demand model used to project aggregate farm output in the National-Interregional Agricultural Projections (NIRAP) modeling system, Tweeten and Quance concluded that the aggregate short-run supply elasticity was .1 for decreasing prices and .15 for increasing prices and that the long-run supply elasticity was .8 for decreasing and 1.5 for increasing prices.

That was in 1969. In updating the parameters and converting the supply-demand relationship to one of simultaneity, Yeh concluded, on the basis of the ability to predict simultaneously seven price, production, and income variables in the 1967–74 period, that the short-run supply elasticity was .2 and the long-run elasticity was 1.0. These supply elasticities were used in our production capacity study. But in simulating the 1967–74 period, Yeh overestimated prices received by farmers in five out of the eight years and underestimated farm output in six of the eight years. One explanation is that the aggregate supply function is becoming more elastic over time (at least in the short run) as inputs that are responsive to price replace inputs such as operator and family labor which are less responsive to price. Our failure to account adequately for the increasing short-run elasticity of supply may have caused us to err on the low side in projecting 1985 equilibrium farm output.

In current revisions of the Economics, Statistics, and Cooperatives Service's long-range projections, the supply elasticity is considered to be .29 in the short run and 1.0 in the long run. This change in short-run elasticity raises 1985 baseline equilibrium farm output 12% to 128 (1967 = 100). By the same year, this adjustment puts equilibrium baseline output 16.1% greater than the 1973–74 average.

The new baseline equilibrium output for 1985 represents a 1.37% compound annual growth rate from 1974 to 1985. This allows the export quantity to increase 3.0% per year and domestic demand quantity to increase 1.0% per year. This domestic demand growth is quite adequate to sustain expected population growth plus an income-induced increase in per capita consumption.

The increasing elasticity of supply would likely increase supply capacity at levels less than feasible supply capacity but could slightly lower the price ratio at which feasible supply capacity would be reached—supply capacity approaches cropland availability and technical capacity at a lower price ratio.

Feasible Supply Capacity

We do not accept Crosson's conclusion that "the 'challenge' to capacity, measured by the behavior of prices, would emerge at levels of output substantially less than the feasible supply capacity. . . ." Crosson contends that our choice of feasible supply capacity at a product-factor price ratio of 180 is not rigorously justified. Because the supply curve does not become perfectly inelastic at any meaningful price, feasible supply capacity must be a judgment call. Here we must leave the formality of the constant supply elasticity incorporated in the model. While there are few kinks in the supply curve, one may occur where land most readily convertible to crops is exhausted. As stated in our paper, at the feasible supply capacity (price ratio of 180) an estimated 595 million acres are required to produce the capacity output in 1985. This would utilize the current cropland base of 472 million acres plus all of the 100 million acres of noncropland identified as having high potential for conversion to cropland and 23 million, or half, of the 48 million acres of noncropland identified as having medium potential for conversion to cropland.

Land is only one factor of production and farmers could produce additional output on the limited land base by using more operating inputs, such as fertilizer, and more durable inputs, such as machinery and irrigation facilities along with better managerial practices. As real price rises and cropping is extended to marginal land, the supply elasticity eventually falls. Even with a constant supply elasticity, marginal absolute response of output to a given change in price is less at high prices than at low prices. Use of a price ratio within a reasonable range around 180 to represent feasible supply capacity would not have markedly changed our conclusions. As ESCS periodically revisits the production capacity question, resource economists will be striving to add more insight to the issue of cropland conversion potential.

Conclusion

Our production capacity analysis was prepared at a time of concern, even hysteria, that the world was losing capacity to feed itself. Many held that capacity of American agriculture would be insufficient to meet food demands at home and abroad. We trust our article helped allay those fears. With mounting commodity surpluses, the ground has shifted from concern over food shortages to concern over rising real food prices in the future. We feel, based on our results, that American agriculture is unlikely to be challenged by 1985 even on this more restrictive interpretation. Americans are likely to spend a lower percentage of their income on food in 1985 than in 1974. New technologies are being introduced and adopted, and productivity of farm inputs is likely to continue to increase (a rate of 1% per year on the average is our estimate). Continued high inflation poses problems, however, as farmers pass on higher input costs by restricting input use and output, entailing a real cost to society in terms of foregone goods and services.

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Publications

Books Reviewed

Note from the Book Review Editor

In keeping with the procedure established for volume 1 of *A Survey of Agricultural Economics Literature* (see the May 1978 issue of this *Journal*), volume 2 with the subtitle *Quantitative Methods in Agricultural Economics, 1940s to 1970s* is being reviewed. Again, three individuals have been asked to review independently the entire volume. The whole book review section of this issue has been devoted to this work. To treat the volumes of *A Survey of Agricultural Economics Literature* in this manner seems appropriate as their preparation has consumed substantial professional inputs. Similarly, their use by and impact on the agricultural economics professional could be great.

Herbert H. Stoevener

Martin, Lee R., ed. *A Survey of Agricultural Economics Literature,* Vol. 2. Minneapolis, University of Minnesota Press, 1977, 473 pp., $25.00. $18.00 to AAEA members through 30 November 1979.

Quantitative Methods in Agricultural Economics, 1940s to 1970s is the second of the three-volume set of reviews commissioned by the American Agricultural Economics Association to cover the professional literature in the field. The volume is concerned with quantitative methods in agricultural economics and consists of four major parts.

Part 1, by George Judge, reviews economic, statistical, and agricultural economic contributions to the solution of measurement problems, development of analytical methods, and uses of economic data that have been made over the last three decades. The paper points out that the 1940s saw the development of methods consistent with the nonexperimental nature of economic data. The paper discusses the refinements to these methods made during the 1950s and the use in the 1960s of sample and prior information in making inferences. The 1970s brought estimators consistent with economic decision making and served to broaden the inference framework to include systems analysis and control theory.

Part 2, which contains a paper by Richard Day and one by Richard Day and Edward Sparling, reviews mathematical, economic, and agricultural economic contributions to optimization theory and methods that are used in applied economics. The areas of application include food and nutrition, farm and agribusiness management, farm growth and development, production response studies, spatial economics, natural resource management, and agricultural development problems.

Also in part 2 is a paper by Roger Woodworth which reviews production function studies and gives credit to multidisciplinary efforts for major accomplishments. A finding for some crops that optimization of input levels does not make it worthwhile to vary greatly levels of inputs is important, but may indicate that economists have overemphasized the importance of economic optima.

Part 3, by S. R. Johnson and Gordon Rausser, reviews simulation methods and system concepts as they have been applied in agricultural economics, economics, management science, statistics, and education. Agricultural economics applications discussed include gaming; process, firm, and market models; aggregate models; economic development and natural resource models. This broad array leads one to the conclusion that there is no system for classifying models.

Part 4 has a paper by M. L. Upchurch on developments in agricultural economic data. It provides the best of the book's surveys of the history of the institutional arrangements, intellectual advancements, and problem situations in which the literature on agricultural and economic data evolved from the 1920s.

Part 4 also contains a paper by several people from the Statistical Reporting Service of the U.S. Department of Agriculture, a paper by James Bonnen, and another by W. Keith Bryant. These three are more like afterthoughts and evaluations than an intellectual survey of agricultural economics literature. Another such paper, by Richard Foote, followed the Judge chapter in Part 1. The Foote paper reports on one man's experience with econometric techniques and is really the only one that doesn't narrow the reader to a "bored yawn," as Bonnen puts it.

Each part or chapter is followed by a list of references which are valuable—there are approximately 100 pages of references. A random sample of five pages, one from each major reference section, showed the following distribution of the sources of the references:

Source of Reference	Percentage of References
Agricultural economic journals	18.7
U.S.D.A. publications	11.7
Nonagricultural books	11.4
Statistical journals and reports	10.5
Experiment station, extension service and university reports	9.7
Economic journals	8.4
Congressional reports and nonagricultural governmental reports	8.1

Proceedings and/or papers from workshops, conferences, meetings	6.3
Nonagricultural, noneconomic and nonstatistical journals	6.1
Agricultural economic books	4.4
Council and foundation reports	2.7
Other	1.6
M.S. and Ph.D. theses	.4
	100.0

The introduction to the book, by an unnamed author, starts with some heavy positivistic material from outside of agricultural economics on how and why knowledge is accumulated. The introduction ends with a review of each chapter of the book. The epilogue, also by an unnamed author, concludes that the review of the literature in volume 2 has been too compartmentalized and not integrated. One cannot disagree with that conclusion.

The agricultural economics profession owes a debt of gratitude to the five editors of volume 2 for providing a comprehensive survey (1940s to 1970s) of quantitative methods in and for agricultural economics. Four of the editors, George Judge, Richard Day, S. R. Johnson, and Gordon Rausser have provided major contributions to the quantitative economics literature upon which agricultural economists depend for their mathematical, statistical, and econometric methods. Lee Martin is the general editor of this volume, as well as of the other two volumes of surveys commissioned by the American Agricultural Economics Association.

The four papers in this volume authored by Judge, Day, Day and Sparling, and Johnson and Rausser persuade us that agricultural economics depends upon other disciplines for the development of quantitative methods. However, one must doubt that the diffusion of these methods into agricultural economics is through the literature of economics, statistics, econometrics, and mathematics. This doubt arises most strongly after reading M. L. Upchurch's paper on developments in agricultural economic data. Upchurch relates the historical development of data acquisition as it evolved with changing agricultural problems, building of institutions, and the intellectual contributions of individuals. While most of the effort cited by Upchurch is USDA-related, he also points out that different schools of thought in the agricultural economics profession have influenced data developments. This recognition of the interaction between problems, institutions, schools of thought, and individuals is notably lacking in the Judge, Day, Day and Sparling, and Johnson and Rausser papers. These papers read as though the American university-experiment station-extension service establishment did not exist. They read as though there is no teaching function performed within these establishments. Having been educated by and experienced with these institutions, this reader believes that the diffusion, development, and use of quantitative methods into and by agricultural economics is mainly through the process of teaching and writing of theses. The fact that M.S. and Ph.D. theses were virtually ignored (.4% of the references for the volume) illustrates that these authors were either not familiar with the land grant system or did not recognize that the accumulation of knowledge involves institutions, teachers, researchers, power, money, and students in agricultural economics. If the authors chose to review only published material, then no reference should have been made to theses or other unpublished material, e.g., regional committee reports, conferences, meetings, and mimeos.

The foreword to the book refers to the selection of outstanding agricultural economists to prepare the papers in this volume. Judge, Day, and Rausser are not listed in the November, 1976 Handbook-Directory of the *Journal*. S. R. Johnson has only his name and address included. These authors and Sparling contributed about 300 of the book's 473 pages. Of these 300 pages, 145 are contributed by Johnson and Rausser under the heading of "Systems Analysis and Simulation in Agricultural and Resource Economics." Some justification for this coverage is given in the epilogue where it is concluded that systems concepts have been useful in understanding and modeling highly complex structures and that the evolutionary research process itself can be cast in the adaptive control framework. Johnson and Rausser emphasize that which is implicit in all the chapters, that "the theory of adaptive or dual control provides a framework sufficiently general to unify the modeling and research process" (p. 472).

The adaptive control problem is mathematically specified on page 179. The nonmathematical reader should not be deterred by the seemingly obscure presentation (a diagram would have helped greatly), for following the equations are enough words to raise doubt as to the generality of the adaptive framework. Although the notion of adaptive control is appealing to describe the research process, the Johnson and Rausser formulation has the objective or preference functions, the planning horizon, and the initial conditions all assumed known. Furthermore, they say the states of the actual world are measured accurately, and that random disturbances to the system through time are independent of one another. These assumptions hardly apply to the university-experiment station-extension service establishment mentioned previously as one of the important generators of agricultural economics research. Preferences, and hence the objective function, frequently change as the problem situation changes. The research process is adaptive to the problem situation, as Upchurch points out. As new institutions are formed to handle social problems (control variables), the preferences can change in unpredictable ways. The feedback loop to the function W is not included in the Johnson and Rausser formulation. While they recognize now that a system can only be defined with a purpose, their formulation of the research process does not define how a research problem can arise (an earlier version of their paper, which this reader reviewed, had defined a system without including a purpose).

A researchable problem can arise when the gap between what we perceive as the states of nature and what we perceive as our purposes (either of which could have been transformed by a function like ϕ) becomes sufficiently welfare-decreasing that we set out to do something about it. Because the research process is a social process and purposive, its purposes can change, giving rise to the problem solving situation. To make this point emphatic, Bonnen says: "data collection and analysis always have a purpose and can only be understood fully in a social system or decision context" (p. 398).

Because Johnson and Rausser do not recognize the research process as a social process, they are led to the criticism of agricultural economics system simulation research as being overly personalized. They say a major limitation associated with systems analysis and simulation is the close identity of the model with the researchers. As the history of science and of economics relates, the process of inquiry is a highly social and personalized process. On the first page of the introduction to this volume, a letter is mentioned from Alfred Marshall to A. L. Bowley giving advice on how to proceed with economic inquiry. In many cases, history shows, important research results are contained in personal letters of which the public may become aware only years after the persons who wrote or received them are dead. It is not at all clear that such personalized research results are suspect if they satisfy the criteria of scientific research. Research is not unscientific because it has only a personalized purpose. This distinction is not at all clear in the adaptive framework that the authors propose as the alternative to current practice in systems simulation research.

There are two statements in the Johnson and Rausser paper which are unsubstantiated by the material covered or by this reader's experience. One appears on page 237 and reads: "The shopworn and increasingly suspect argument that systems analysis presents a method for analyzing problems without a criterion function will soon lose its acceptance." The second statement is on page 238 and reads: "Contrary to rather widely held opinions, the advent of systems and simulation concepts has not freed us from our previous preoccupation with economic theory and quantitative methods." These statements are incredible and serve no purpose in this volume.

There are also two statements concerning history which this reader views differently. One, on page 224, says that the "ambitious Nigerian model developed at Michigan State University had its origins (both data requirements and conceptualization) in early applications of systems concepts by Holland." As this reader recalls, the full (still unpublished and not referenced by the authors) Venezuelan report of Holland was unavailable to this reader as a member of the Michigan State team until he located it in Venezuela several years after the Michigan State University work started. The reference to Holland and Gillespie's work in India was available; but, as this reader recalls, it was used as an example of what not to do in systems simulation rather than as the origin of conceptualization or data requirements. The impossibility of applying the Holland and Gillespie model (albeit in India) was something which the Michigan State team continually strove to avoid.

The second statement with which I would disagree appears on page 225 and reads: "the work of Halter and Miller (1966) had a marked influence on the models constructed at Michigan State University for Nigeria and Korea." Thomas Manetsch presented his Ph.D. thesis in electrical engineering at Oregon State University in December of 1964. Manetsch had a marked influence on this reader in courses and as Manetsch's thesis advisor. Before Manetsch finished his work this reader went to the University of California at Davis to work on the range-feedlot study with G. W. Dean (1965). After finishing his thesis, Manetsch went to the University of California at Los Angeles where he worked on the Brazilian models (Manetsch 1967). In 1966, at this reader's recommendation, he was hired by Michigan State University to lead the Nigerian simulation model work. After returning to Oregon State University, this reader worked with Stanley Miller on the river basin simulation model (1966). It is very unlikely that Johnson and Rausser could have learned these details from published agricultural economics literature. They might have pieced it together had they carefully looked at Ph.D. theses. In this case, they probably would have missed an important electrical engineering thesis and, hence, the connecting link. However, had they chosen to review the history of the accumulation of knowledge and experience in the systems simulation area of agricultural economics and discovered the important interactions among institutions, individuals, disciplines and problems, the survey could have been more accurate, more interesting, and more reflective of the social nature of the research process.

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A Survey of Agricultural Economics Literature, Vol. 2.

To review a book of survey articles is not an easy task. The articles in this volume are comprehensive and well written by scholarly individuals with considerable experience. It doesn't leave the reviewer with much to say that has content and is meaningful. The reviewer is left with identifying omissions (which are probably marginal), pecking at the quality of writing and organization, and giving his view of the usefulness of the publication. This is what this review attempts to do.

Part 1 consists of two chapters concerned with estimation and statistical inference in economics. In the first chapter, George Judge provides a comprehensive coverage of the historical development of theory and methods of estimation and statistical inference in economics from the early works in the 1920s and '30s to the present day. Judge covers the major developments in this area, most of which occurred in economics, statistics, and mathematics. Frequently, survey articles of this nature are boring but this chapter is one of the more interesting ones in the volume. The chapter does short-change forecasting and forecast evaluation, even though these are topics which are of interest to agricultural economists.

The second chapter in part 1, written by Foote, is labeled a discussion of Judge's paper, but it really is not. One can only conjecture that after reading Judge's article Foote concluded, as I did, that there wasn't a whole lot to be discussed or added. Foote relates his experiences with econometric tools from about the mid-1930s to the present day. This short chapter is written with a good balance of humor and content and provides an appropriate ending for part 1.

Part 2 contains three chapters on economic optimization in agricultural and resource economics. The first, by Day, is a comprehensive survey of optimization models from the simplest to the most complex. It is written in a nontechnical, understandable fashion. The reader is spared from equations and matrices; Day explains some rather complex concepts with the aid of a few figures. The reader needs little or no background in economic optimization to get a pretty good feel and appreciation for optimization and the different types of models it uses in economics. Day presents a simple and useful classification scheme for classifying optimization models according to type of choice space, objective function characteristics, and characteristics of restrictions.

In the second chapter of part 2, Day teams up with Sparling to discuss the application of optimization tools in agricultural and resource economics. They cover the major categories of applications including food and diet, farm and agribusiness management, farm firm development, production response, interregional and spatial economics, natural resources, and agricultural development. The contributions discussed in this paper were selected on the basis of their importance from an historical point of view, as representative of an important research area, or as being of contemporary interest. The coverage of techniques is comprehensive ranging from simple budgeting to complex optimal control theory and recursive programming.

The third chapter in part 2, written by Woodworth, is a good historical survey of agricultural production development and estimation. Studies concerned with aggregate, crop, and animal and livestock production functions are considered. Woodworth assesses the strengths and weaknesses of these types of studies and points out that agricultural production function research demonstrates the potential accomplishments of interdisciplinary approaches to problem solving. Even though this chapter is a thorough and fairly interesting treatment of agricultural production functions, it is somewhat a misfit in this part of the volume concerned with economic optimization in agriculture and resource economics. The other two chapters dealt with optimization models, whereas production functions are not optimization models as such, although they may provide a portion of the information needed to determine optimum input levels.

Part 3 is concerned with systems analysis and simulation in agricultural and resource economics and consists of one very long chapter by S. R. Johnson and G. C. Rausser. In the first forty-four pages of this chapter, the fundamentals of systems analysis and simulation are discussed, providing the reader with the basics of systems analysis and simulation and with a systematic basis for evaluating the applications of systems analysis and simulation that are presented in the latter part of the chapter.

A comprehensive coverage of various types of applications of systems analysis and simulation in agricultural and resource economics is presented in the last eighty pages of this chapter. The application areas covered are games and gaming, firm and process, market or industry models, aggregate models, development models, and resource models. In each of these areas a sufficient number of applications are examined so that common characteristics and future trends can be analyzed. The studies in each of the application areas are analyzed with regard to historical development, distinguishing characteristics, and illustrative form, and the models are evaluated relative to guides set forth in the initial part of the chapter. The chapter closes with a critique and appraisal of systems analysis and simulation models in general.

Part 4 of the volume entails four chapters concerned with agricultural economic information systems. This section rather hangs at the end, not fitting well with the rest of the volume. Nor does the volume title, *Quantitative Methods in Agricultural Economics, 1940s to 1970s,* suggest that information systems should be included. Perhaps the title should have included information systems, but one suspicions that this part of the volume was appended after it was realized that the usefulness of information generated by the types of models already discussed depended on good data, and that no survey of quantitative methods would be complete unless data systems were considered. Regardless of organizational shortcomings, the individual chapters are informative and provide useful information about data and information systems in agriculture.

The first chapter in part 4, by Upchurch, focuses on developments in agricultural economic data. This is a scholarly piece of work that looks at the institutions that collect and assemble the various types of agricultural data frequently used in economic analyses. In a rather interesting way, Upchurch discusses the historical evolution of the various data sets and of the institutions responsible for the "feed and care" of the data sets. The purpose, strengths, and weaknesses of the various types of current commodity statistics, farm data, production resources and costs data, marketing data, data on farm related businesses, food consumption and nutrition data, natural resource economic data, international data, and rural area development data are assessed and the reasons for changes in the institutions that provide these various data are discussed. The author closes the chapter by examining some of the present problems with agricultural data and speculating about the future. The chapter provides the reader with an opportunity to share some of the insights of a person who grew up with and spent much of his professional career working closely with the federal data collection system.

The next chapter by Trelogan, Caudill, Huttleston, Kibler, and Brooks focuses on the technical developments in agricultural estimates methodology. This chapter summarizes the historical evolution of the Statistical Reporting Service of the USDA and discusses the changes in technologies for collecting and assembling data. Although informative, one can't help but wonder why this material wasn't condensed and included as part of the previous chapter.

In the third chapter of this part, Bonnen assesses the current agricultural data base from an information system approach. He discusses major difficulties with our information systems, such as obsolescence of concepts, delays in the publication of data, lack of rural social and economic data (because of an absence of a conceptual and theoretical base for collection and analysis of such data), changes in institutional structures of data systems, and resistance to changing the design of data or its collection because of vested interests in various types of data. Bonnen criticizes economists for having added to the problems in our information system by having propagated endless theories, concepts, and models of unknown value because of a failure to design and collect data for adequate empirical tests. Bonnen next sets forth a model of an information system which would provide the type of information needed for public and private decision making and discusses the characteristics and functioning of its component parts. He concludes, and most would agree, that we have undervalued our agricultural information systems so greatly that there has not been adequate investment in some systems while others have been allowed to decay.

In the final chapter, Bryant addresses himself to some of the data issues in rural economics and social statistics. Although growing, the demand for social and economic statistics is small relative to the demand for knowledge about commercial agriculture, and it is a subpart of the demand for data about people in general. Rural economics and social statistics are based on small areas, and current sampling methods—along with decentralized collection agencies at the federal level with limited funds for collecting these types of data—have limited the supply of rural economics and social data. Bryant points out that if the decentralized system of collecting and assembling rural economics and social data is to prevail, then more funding is needed for this decentralized system, and institutional channels need to be devised through which the work of the system can be communicated, criticized, and incorporated into the national information system. The large-scale social experiments, such as those dealing with cash welfare programs, are useful approaches to generating rural economic and social data. Bryant mentions some of the problems arising from restrictions on disclosure of certain types of data. These are quite severe and are likely to become even more so.

The volume closes with an epilogue summarizing the main thrusts of the different parts of the volume and the component chapters of each part. The reader can read the introduction—which outlines the chapters of the volume—and the epilogue to obtain a feel for the nature of the material in the volume. I suspect many will want to do this. Probably few readers will plow through from cover to cover. Although the volume is well written, this type of survey material is not particularly exciting; in fact, some sections of some chapters, even though informative, are outright dull.

This is an appropriate volume for public and private libraries servicing researchers in agricultural economics and people interested in agricultural and social data. Most agricultural economists and economists interested in quantitative methods and data systems would find a personal copy useful. The comprehensive list of references is of value in itself. There are approximately 102 pages of references and somewhere between 2200 and 2400 individual references, although a number of duplications occur. Those teaching various types of quantitative courses also would find certain sections of this volume appropriate and useful as reading materials for their classes.

I think we can all be glad that the AAEA commissioned this and the other volumes. With the rapid proliferation of materials in areas of quantitative methods, some consideration should be given to keeping this survey updated, perhaps in special issues of the *AJAE* at specified time intervals.

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A Survey of Agricultural Economics Literature, Vol. 2.

The theme of this volume is the need for a more fully integrated approach to problem specification, data generation, estimation, model revision, and application for policy analysis. This reviewer suggests that the epilogue be read first because it provides the essence of the editors' views of the contributions to the volume. The theme of integration is hammered home at least twelve times. Further, the editors apparently conclude that an adaptive control framework provides the needed framework for our research—an interesting idea, but one that is not fully developed to say the least.

George Judge's article on "Estimation and Statistical Inference in Economics" is an excellent review, from the "roots" of econometrics to speculations on future developments. It is a cut through time, one man's view of developments in theory and applications, with the emphasis mainly on econometric methods. Thus, one must look elsewhere for a focus on problems rather than method. The guided tour through the 1950s is well done and is familiar territory to most of the profession. He notes that the results were "seldom if ever used for decision purposes," which statement serves to whet our appetites for developments that "almost always" are used for such purposes. The review of the 1960s does provide solid fare but not much evidence that the break from the past was successful. Bayesian decision theory receives strong support but with the note of nonavailability of viable computer programs for certain problems. Some feel mixed estimation procedures of the classical approach accomplish much the same goal. Note also is made of developments in systems analysis and control theory, a subject of a subsequent essay. Other important developments during this decade are noted, such as two- and three-stage least squares. Many of these developments are now incorporated in econometric textbooks following the classical tradition. The problem of multicollinearity, which plagues all econometric work, is still a serious problem in the highly sophisticated models because of lack of adequate ranges of observations. Interesting discussion also is given to the development of large econometric models. The author's section on the 1970s reviews some reservations on the predictive ability of such models, and suggests "perhaps we expect too much from these quantitative ventures" (p. 32). There is much to be gained from a careful reading of Judge's paper, both in review of accomplishments and in areas for continuing research.

Dick Foote's short commentary is another "one man's view" of the world of econometric modeling. Many of us have learned much from Foote and his ability to present complex ideas in understandable terms. His honesty in presenting ideas that don't work as well as those that do is a refreshing breeze to the readers who wonder if it ever will be possible to select the "optimum" strategy of research design, data collection, and analysis of meaningful problems of today.

Day's review "On Economic Optimization: A Nontechnical Survey" is well worth reading by the entire profession. The writing is clear and the figures clarify points, particularly on the nature of objective functions and restraints. A nice contrast is made between classical and neoclassical approaches to optimization. Also, he notes the parallel nature of parametric programming in optimization theory and comparative statics in economic theory. There is a clear development of the interface between game theory and optimization, and of questions of decentralized decision making. It is important to note developments on objective functions where multiple goals are involved. (Problems here become even stickier if we are to accept the editors' emphasis on control theory with possible multiperiod objective functions.) References to risk and uncertainty are mainline contributions with agricultural economists' contributions discussed in the following article. The discussion on dynamic optimization is useful, but it would have been a real service to the profession if he had given us the graphics of control theory with some notes on its strengths and pitfalls. Most readers would be well advised to accept his recommended reading of Intrilligator on control theory and dynamic programming. His comments on recursive optimization modeling are informative and are based on his extensive work in this area. This reader appreciated his comments on some of the mind-boggling aspects of intertemporal optimality and his concluding philosophical thoughts on optimizing models.

Day and Sparling, in "Optimization Models in Agricultural and Resource Economics," provide a compact 35-page essay covering selected research in seven areas such as interregional and spatial economics and natural resources. This should be useful to the profession as a reference and for teaching purposes, supplementing reviews such as that by Weinschenck, et al., for example. The natural resource applications have emphasized the multiperiod nature of the problem, and the review provides an excellent survey of the problems and methods used. The authors do not speculate on future developments and confine attention to a useful review of primarily U.S. research completed up to 1973. Various other developments and applications of optimization models have been published since that time. The work on risk might be noted, as well as applications to problems other than natural resources and commercial agriculture.

Woodworth's review of "Agricultural Production Function Studies" is perhaps by definition more narrowly oriented than other papers in the survey. But in reading Dillon's 1977 second edition of *The Analysis of Response in Crop and Livestock Production,* it was apparent that some of the richness of recent inquiries was lacking in the paper under review. More attention might have been given to quantitative approaches to response efficiency over time and to risk. Production function research and related supply response approaches appear to be placing emphasis on risk, combining cross-section and time-series data, dynamic programming, and on combining methods such as production functions and linear programming for analysis of animal feeding. These comments are meant to supplement rather than detract from the useful review comments. One of the important accomplishments stressed is the successful cooperation among production scientists and agricultural economists in developing response functions. A question is raised as to the economic importance of determining the optimum level, but such events as increased energy costs, environmental concerns, and decisions under risk suggest the work of the past decades has provided a sound basis for future work. Programming models generally use simple representations of response surfaces, but it is important to understand the adequacy of such simplifications. Woodworth also emphasizes the higher payoff of such production function research in developing countries. Perhaps the important lesson to be learned is that agricultural economists must continue to work with researchers in other disciplines if our efforts are to be of long-run significance in this area.

Stan Johnson and Gordon Rausser's review of "Systems Analysis and Simulation" can be considered as two separate essays. The first forty-four pages essentially are an essay in persuasion on the integrative strengths of an adaptive control framework. The second section, on applications of systems analysis and simulation (starting on p. 201), provides an excellent analytical review of selected studies in four areas: games and gaming, firm and processes, market or industry models, and aggregate models. Many readers might enjoy starting on the familiar ground of the second section before going to the first section where the more esoteric philosophy of research design is discussed. For each area, such as market or industry models, the authors provide the history of applications, distinguishing characteristics of the models, illustrative forms (e.g., decision models vs. descriptive studies), a survey, and a summary and evaluation. There is an instructive table of references for each area, providing such information as the objectives of each study, its major components, the decision variables, and model characteristics (dynamic, stochastic, nonlinear). The authors also provide their ideas on how such modeling can be improved in validation, design of simulation experiments, or objective function specifications. The authors appear convinced that adaptive control framework is the means of integrating such research, but they warn us not to "rush out and purchase a copy of the latest text on control theory (p. —)." This raises what to me seems to be a limitation to the development in the first part of the paper on adaptive control. Surely it would have been possible to broaden the readership with a less awesome splash of mathematics (p. 179) and the introduction of some intuitive notions of types of variables in the state and control sets. They do note that solutions to such problems are as yet limited to highly simplified structures. But they do not discuss the difficulties inherent in the specification of a meaningful objective function for certain problems involving welfare criteria for various subsets of producer and consumer groups. Also, the functional relationships (dynamic, not static!) are often difficult to quantify without adding additional restraints, such that the resulting model is not explosive. Thus, there is more advocacy of the approach than seems warranted at this time, but the authors are to be commended for their attempt at an integrated approach to such modeling.

Part 4 consists of four essays on the need for adequate statistics on commercial agriculture and the rural economy. Upchurch provides a broad summary of developments in the data base with brief comments on the wide range of reports published by the USDA and some of the researchers involved in developing these series. References are provided for more detailed explanation of major series. There are important points stressed in the introduction reminding us, for example, that it is impossible to design a statistical system to satisfy all users; that data systems are costly; that objective methods are replacing subjective approaches; that there has been an imbalance in emphasis on models versus data, with questionable research outcomes; that there are multiple users of data, and what may be appropriate for one set may not be that required for another; that it is easier to meet the needs of users of commodity statistics than to follow the major changes in the structure of agriculture; and that social statistics are even more difficult to obtain. Users of statistics are painfully aware of these limitations, even with commodity statistics where increased industry concentration makes disclosure of key variables (such as prices, inventories, or pack statistics) not advantageous to the individual firm. Many examples come to mind in reading this review, both for commercial agriculture and for the rural economy. For example, some years ago Wilbur Maki and others devised a data system for the livestock and packing sector that would have provided valuable information on interregional competition, only to have one firm refuse cooperation and, thus, to have all others follow suit.

Trelogan, Caudill, Huddleston, Kibler, and Brooks provide an interesting review of "Technical Developments in Agricultural Estimates Methodology." A reading of this brief review of methodological advances in sampling techniques during the past decades and of future possibilities, such as remote sensing, should increase our appreciation for the many contributions of economic statisticians in providing a sound basis for economic analysis.

Bonnen draws from his previous writings in providing an "Assessment of the Current Data Base: An Information System Approach." Bonnen argues that "an information system includes not only the production of data but also the analysis and interpretation of these data in some purposeful policy decision or problem solution context" (p. 397). He stresses that data systems should be developed for problem solving and that the agricultural economist must not leave the task of data production entirely to the statistician. Thus, he argues that data collected for societal decision making must have a social theory base and that data and theory are interdependent. When change is rapid, the information system must be redesigned to track these changes if we are to avoid obsolescence in our data base. He argues that the information system should be designed for the decision maker, and that we should "think more about the nature of social systems of which information systems are an inherent part" (p. 403). Some examples would help to bring this fairly esoteric material down to earth. It seems to me that data systems are designed for various decision makers and compromise is always present. Further, the profession may not claim an outstanding record for identifying problems, such as an oil or trade crisis, before the fact and of convincing those in charge to get the needed statistical apparatus on line. But Jim Bonnen's paper is the type of challenge that is needed and it is recommended reading.

The concluding essay by Keith Bryant on "Rural Economic and Social Statistics" provides more problem orientation than most essays in this volume. The demand for such statistics is not confined to rural areas and cuts across several social problems. Various federal agencies are involved, and yet much of the need for specifics is at the state or local level. On the supply side, cost considerations lead to sampling that is more meaningful at a national level. Bryant notes a "retreat of the USDA from its position as the federal agency for rural people to the federal agency for commercial agriculture . . ." (p. 414). Further, there is insufficient knowledge of the extent of overlapping programs at the local level. Bryant summarizes suggestions for improvements, giving emphasis to the decentralization of data collection to specific local situations, with funds provided by NSF and USDA to land-grant researchers for particular economic and social problems. This idea should be pursued.

This reviewer would have appreciated the ideas of these researchers with a more specific problem focus, and suggested methods for analyzing alternative ways of meeting perceived societal goals. The data needs would then be more apparent. Perhaps this is the next step.

The authors and editors are to be commended for their substantial contribution in reviewing progress in the last forty years and in highlighting how much remains to be done.

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Duby, Georges. *The Early Growth of the European Economy.* Ithaca, N.Y., Cornell University Press, 1978, x + 292 pp., $5.95 paper.

Dunkerley, Jay, Ed. *International Comparisons of Energy Consumption.* Baltimore, Md., Johns Hopkins University Press, 1978, xxxiii + 218 pp., $7.50.

Food and Agriculture Organization of the United Nations. *Report on the FAO/SIDA/DSE Inter-Regional Symposium in Integrated Rural Development.* Rome, Food and Agriculture Organization of the United Nations, 1978, xii + 121 pp., price unknown.

Hart, John M. *Anarchism and the Mexican Working Class, 1860–1931.* Austin, University of Texas Press, 1978, x + 249 pp., $14.95.

Hill, R. D. *Rice in Malaysia: A Study in Historical Geography.* New York, Oxford University Press, 1978, xiii + 737 pp., $15.00 paper.

Hitch, Charles B. *Resources for an Uncertain Future.* Baltimore, Md., Johns Hopkins University Press, 1978, ix + 105 pp., $7.50, $2.95 paper.

Hoch, Irving. *Energy Use in the U.S. by State and Region.* Baltimore, Md., Johns Hopkins University Press, 1978, xiii + 737 pp., $15.00 paper.

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Lave, Lester B., and Eugene P. Seskin. *Air Pollution and Human Health.* Baltimore, Md., Johns Hopkins University Press, 1978, xx + 368 pp., $22.50.

Maass, Arthur, and Raymond L. Anderson. *. . . And The Desert Shall Rejoice. Conflict, Growth and Justice in Arid Environments.* Cambridge, Mass., MIT Press, 447 pp., $19.95.

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Nortman, Dorothy L., Robert G. Palter, Sharon W. Kermeyer, and John Bongaarts. *Birth Rates and Birth Control Practice.* New York, Population Council, xi + 141 pp., $6.75.

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Portney, Paul R., Ed., and A. Myrick Freeman, Robert H. Haveman, Henry M. Peskin, Eugene P. Seskin, and V. Kerry Smith. *Current Issues in U.S. Environmental Policy.* Baltimore, Md., Johns Hopkins University Press, 1978, xv + 207 pp., $15.00, $4.95 paper.

Rossmiller, George E., Ed. *Agriculture Sector Planning: A General System Simulation Approach.* East Lansing, Michigan State University Press, 1978, xvi + 430 pp., $15.00, $8.00 paper.

Sassone, Peter G., and William A. Schaffer. *Cost-Benefit Analysis: A Handbook.* New York, Academic Press, 1978, xiv + 182 pp., $13.50.

Shofner, Jerrell H. *Daniel Ladd: Merchant Prince of Frontier Florida.* Gainesville, University Presses of Florida, 1978, ix + 180 pp., $8.50.

Stavis, Benedict. *The Politics of Agricultural Mechanization in China.* Ithaca, N.Y., Cornell University Press, 288 pp., $17.50.

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Welsch, D. E., E. A. Persons, D. L. Hodgkins, D. B. Walker, P. R. Hasbargen, and E. J. Weness. *The Account Book: For Farm and Ranch Management.* Minneapolis, Minn., Burgess Publishing Co., $5.25.

Wingo, Lowdon, and Alan Evans, Eds. *Public Economics and the Quality of Life.* Baltimore, Md., Johns Hopkins University Press, 1978, xv + 327 pp., $17.95.

News

Announcements

AAEA Awards Program

Through its awards program, the American Agricultural Economics Association recognizes professional excellence in several subfields of agricultural economics. The AAEA recognizes professional achievement at the student, the young professional, and the more experienced levels in research, teaching, and extension activities. Seventeen awards will be presented in 1979.

The program has a rich tradition as can readily be noted by a review of the roster of award winners over the years. The AAEA believes that this tradition will be continued in the 1979 program.

The 1979 program has been organized and will be conducted by committees representing a substantial professional input of nearly 100 committee members. We hope you will submit nominations for the categories outlined in this announcement. The General Awards Chairman is Daniel I. Padberg, Department of Agricultural Economics, University of Illinois, Urbana, Illinois 61801, telephone (217) 333-1810.

Each of the award programs has been described in the November 1977 issue of the *Journal*, pp. 795–99. Nominations are due by 1 February 1979 for the eight programs, and recommendations of the subcommittees will be forwarded to the General Awards Chairman by 15 May 1979. Nominations and supporting evidence should be submitted to the following persons: Distinguished Extension Programs—Harlan G. Hughes, Division of Agricultural Economics, Box 3354, University Station, University of Wyoming, Laramee, Wyoming 82071; Distinguished Policy Contribution, J. Edwin Faris, Department of Agricultural Economics and Rural Sociology, Clemson University, Clemson, South Carolina 29631; Distinguished Undergraduate Teaching, John D. Helmberger, Department of Agricultural Economics, University of Minnesota, St. Paul, Minnesota 55108; Outstanding Master's Degree Program, Larry J. Martin, Department of Agricultural Economics, University of Illinois, Urbana, Illinois 61801; Outstanding Doctoral Degree Program, Walter W. Haessel, Department of Agricultural Economics and Rural Sociology, Weaver Building, The Pennsylvania State University, University Park, Pennsylvania 16802; Quality of Research Discovery, James B. Hassler, 238 Filley Hall, University of Nebraska, Lincoln, Nebraska 68503; Quality of Communication, David E. Kenyon, Department of Agricultural Economics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061; and Publication of Enduring Quality, Gerald A. Doeksen, Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma 74074.

Outstanding Journal Article

The editor and editorial council of the *Journal*, with the editor as chairman, will choose the outstanding article in the 1978 volume of the *Journal*.

AAEA Fellow

Nominations for AAEA Fellow should be sent to the secretary-treasurer, John C. Redman, University of Kentucky, Lexington by 1 December 1978. Any living AAEA member may be nominated. Those submitting nominations should be prepared to submit, upon request, biographical information in support of the nominee.

General Recognition

Awards will be presented at the annual AAEA awards program during the annual meeting at Washington State University, Pullman, Washington, 29 July–1 August 1979. Winners will be identified in the annual meeting awards program brochure and in the December proceedings issue of the *Journal*.

Nominating Committee

American Agricultural Economics Association president-elect B. F. Stanton has appointed the following as members of the nominating committee for 1978–79: chairman, R. J. Hildreth, Farm Foundation; Jerry Cole, University of Delaware; Ralph W. Cummings, Jr., International Agricultural Development Center; J. E. Faris, Clemson University; Gene Futrell, Iowa State University; Timothy Hammonds, Food Marketing Institute; John Stovall, ESCS, USDA; and Norman Whittlesey, Washington State University.

Individual members of the Association should submit their suggested nominees to Kenneth Farrell, Economic Research Service, U.S. Department of Agriculture, 500 12th St., S.W., Washington, D.C. 20250, by 10 December 1978.

The committee will nominate two persons for the office of president-elect and two sets of paired candidates for directors of the Association.

Errata

In "Scarcity and Growth Reconsidered," by V. Kerry Smith, in the May 1978 issue of the *Journal*, equation (2) on p. 286 should read as follows:

$$(2)\quad (w^* = r^*) = \frac{(N^* - L^*) + (\bar{R}_N - \bar{R}_L) + (\bar{R}_{KN} - \bar{R}_{KL})}{|\theta||\lambda|(\epsilon_D + \epsilon_T)} + \frac{(\epsilon_{IE} - \epsilon_{INE})I^*}{|\theta|(\epsilon_D + \epsilon_T)} - \frac{\epsilon_D[(T_{NE} - T_E) + (\tau_{KNE} - \tau_{KE})T_K]}{|\theta|(\epsilon_D + \epsilon_T)}.$$

In "A Model of Crop Selection in Semi-substance Agriculture and an Application to Mixed Agriculture in Fiji" by A. John De Boer and Satish Chandra in the August 1978 issue of the *Journal*, the diagrams (but not the captions) in figures 1 and 2, pp. 439–40 were inadvertently transposed.

Social Science Studies Division Established in AID Office of Evaluation

As a result of its recent reorganization, the United States Agency for International Development has established a studies division within its newly created Office of Evaluation. The function of the division is to analyze the intended and unintended impact of alternative types of development projects and programs on the income, nutrition, health, and demographic behavior of low income people and on the socioeconomic and environmental systems on which their present and future welfare depends.

The Division will try to find out what has been learned from past experience by tapping the knowledge of social scientists and development practitioners (especially host country nationals) and the intended beneficiaries of development assistance. While it is expected that the division will conduct field studies, commission reports, and organize workshops, it will not fund basic research.

It would be helpful to the Division's staff if individuals who have had extensive experience with AID projects or programs would write brief letters indicating their names and addresses, their disciplines or professions, the countries in which they have observed AID activities in depth, the nature of the activity they have observed, and references to any work they may have published on their experiences. Both constructive criticism and observations on projects or programs that seem to be working well are of particular interest. Address: Allan Hoben, Room 3673 NS, A.I.D., Washington, D.C. 20523.

Singapore ADC to Bangkok

The office of the Regional Research and Training Program of the Agricultural Development Council has moved from Singapore to Bangkok. The new address is Agricultural Development Council, P.O. Box 11-1172, Bangkok 11, Thailand; cable address is AGRIDEVEL, BANGKOK.

World Soybean Research Conference II

The world soybean conference at Raleigh, North Carolina, 26–29 March 1979, will provide a forum for the presentation and discussion of recent advances in soybean production, marketing, and utilization. A previous conference was held at Champaign-Urbana, Illinois in 1975. Scientists from all nations engaged in soybean research are invited. More detailed information is available from Dr. Billy E. Caldwell, World Soybean Research Conference II, North Carolina State University, P.O. Box 5155, Raleigh, North Carolina 27650 U.S.A.

Bank of Northeast Brazil Fellowship Program Revised

The Bank of Northeast Brazil has recently revised its fellowship program for graduate students doing doctoral dissertation research.

Fluency in Portuguese or Spanish is required, and the candidate must do research on a topic relating to the development of Northeast Brazil. Financial support is provided for a period of up to eighteen months and consists of the cruzeiro equivalent of $600 per month for the candidate plus $150 per month for spouse and $75 per month for each child (up to two) if accompanied by the candidate; round trip air fare for the candidate and family; funding for research expenses as justified by the candidate's research proposal and approved by the Bank; and health and accident insurance for the candidate and dependents during the fellowship period.

Agricultural economics is one of the fields supported by the program. To receive a brochure giving further details of the program and the necessary application form, write: Banco do Nordeste do Brasil, S.A.; Secretaria Executiva do FUNDECI; Caixa Postal, 628; 60.000 Fortaleza, Ceara, Brasil.

Personnel

University of Arizona

Appointment: David L. Barkley, formerly at University of Redlands, is an assistant professor.
Return: Roger Fox has returned from a sabbatical spent at the International Food Policy Research Institute, Washington, D.C.
Resignations: Louise M. Arthur, adjunct assistant professor; **John Fischer,** professor of agricultural economics, is dean of the faculty of agricultural sciences, American University of Beirut, Lebanon.
Retirement: Aaron G. Nelson, professor and economist, has been designated professor emeritus.

University of California, Davis

Appointment: Robert A. Collins, formerly at Northwest Missouri State University, is assistant professor.
Leave: Leon Garoyan, extension economist, is serving on the President's Reorganization Project on the Food and Nutrition Study.

Clemson University

Appointments: Dennis P. Helmreich, M.S. University of Georgia, is visiting instructor, economics of small minority firms and cooperative production and marketing enterprises; **James C. O. Nyankori,** Ph.D. University of Illinois, is assistant professor of consumer economics and marketing.
Leave of Absence: W. J. Lanham is on a one-year leave until 31 July 1979 as senior staff economist with the U.S. Senate Judiciary Committee, in Washington, D.C.

Cornell University

Leaves: Donald K. Freebairn, associate professor, is on leave with the Center for Agricultural Economics in Chapingo, Mexico, for the 1978–79 academic year; **William G. Tomek,** professor, is on leave with the Economics, Statistics and Cooperatives Service, USDA, in Washington, D.C., for the 1978–79 academic year.
Honors: Edward A. Lutz, professor emeritus, received the Life Membership Award, from the Northeast Agricultural Economics Council, Durham, New Hampshire.

University of Florida

Appointment: Walter J. Milon, Florida State University, is assistant professor.
Return: Charles D. Covey has returned from a leave in the British Isles, where he studied English and Scottish Extension Services.

University of Guelph

Leave: Truman P. Phillips, associate professor, is on a one-year sabbatical leave to conduct research on the viability of establishing a cassava-based starch-alcohol system at the Centro Technologia Promon, Rio de Janeiro, Brazil.

University of Hawaii-Manoa

Honor: Chennat Gopalakrishnan, professor of resource economics, has been appointed the first Law of the Sea Institute Professor of Social Sciences for a one-year period effective 1 January 1978.

University of Illinois

Appointment: Randall E. Westgren, Ph.D. Purdue University, is an assistant professor of agricultural and food marketing.
Leave: Bruce L. Brooks is on a two-year leave of absence with the USDA in Jamaica.

International Rice Research Institute

Appointments: John Flinn, International Institute of Tropical Agriculture, Nigeria, is an agricultural economist; **Grace Goodell** is a visiting anthropologist; and **Robert W. Herdt** is head of the department.
Resignation: Randolph Barker has joined the Department of Agricultural Economics, Cornell University.

Iowa State University

Appointment: Peter Calkins is an assistant professor, and **David L. Reinders** is research associate in the Department of Economics.
Resignation: Richard Maxon, professor of economics in the Cooperative Extension Service, has accepted a position at Kansas State University.
Honor: Earl O. Heady was elected to the first

CED, Commodity Economics Division; **EDD,** Economic Development Division; **ESCS,** Economics, Statistics, and Cooperatives Service; **FDCD,** Foreign Demand and Competition Division; **NEAD,** National Economic Analysis Division; **NRED,** National Resource Economics Division; **OA,** Office of the Administrator.

"Henry A. Wallace Award" for contributions to national and international agriculture by the Iowa State University Alumni Association.

University of Kentucky

Resignation: **A. Frank Bordeaux, Jr.,** associate professor, is an agricultural economics analyst in the Resource, Planning, and Development Unit, North Carolina Department of Agriculture.

Michigan State University

Appointments: **Larry Connor** is professor and department chairman for a five-year term effective 1 August 1978; **Lester V. Manderscheid** is professor and associate chairman; and **Eileen Olson van Ravenswaay** is assistant professor in public affairs with specialization in organization theory.
Return: **Mike Weber** has returned from two years with the Michigan State University Brazil project at Fortaleza.

University of Minnesota

Resignation: **John J. Myers** is with the U.S. Army Judge Advocate General's Corps at Ft. Riley, Kansas.

Mississippi State University

Appointment: **Albert J. Allen** is assistant professor and assistant agricultural economist.

University of Missouri

Appointment: **Maury E. Bredahl,** formerly with ESCS, University of Minnesota, is an assistant professor.
Leave: **Jerry G. West** will serve as social scientist with the Sciences and Education Administration/Cooperative Research, in Washington, D.C., for a one-year period beginning 15 August 1978.
Honor: **Stephen F. Whitted** was awarded the title professor emeritus.

University of Nebraska

Appointment: **Tim Lowry,** Ph.D. University of California, is assistant professor of agricultural marketing.
Retirement: **Philip A. Henderson,** retired 1 September, after 28 years of service.

University of Nevada

Appointments: **John A. Knechel,** formerly vice president of the Council of California Growers and of the Agri-Business Analysis Department, Bank of America, is associate professor of agricultural and resource economics and Community Resource Development Program Leader; **Michael E. Wetzstein,** formerly a graduate intern at the California State Air Resources Board, Sacramento, is assistant professor of natural resources.

North Carolina State University

Appointments: **Geoffrey A. Benson** is assistant professor; **Marc A. Johnson,** formerly at Oklahoma State University, is associate professor; **Susan W. Johnson** is lecturer; **Daniel A. Sumner,** formerly with Rand Corporation, is assistant professor; and **Michael L. Walden** is assistant professor, all in the Department of Economics and Business.

Ohio State University

Appointment: **Robert Chambers,** Ph.D. University of California, is assistant professor of agricultural marketing.
Honor: **Francis B. McCormick** received the Outstanding Service to Students Award of the College of Agriculture, Home Economics, and Natural Resources.

Oklahoma State University

Appointments: **Mike L. Hardin** is assistant professor in Farm Management; **Clint E. Roush** is assistant professor in agricultural finance; **W. Keith Scearce** is assistant professor in public affairs and policy; and **Clem E. Ward,** formerly with FCS-ESCS USDA, is associate professor in livestock marketing.
Leave: **Loren L. Parks** is in-country coordinator for two years in Tegucigalpa, Honduras, on the Small Farmer Credit Project.

Oregon State University

Leave: **Jean B. Wyckoff** is on a one-year sabbatical leave with the USDA Extension Service and ESCS, in Washington, D.C.
Resignation: **Clinton B. Reeder,** associate professor, will pursue farming and private consulation in Pendleton, Oregon.

Purdue University

Appointment: Kim A. Cook, B.S. Purdue University, is a community development analyst.
Resignations: Paul N. Blick has returned to his own business in Andale, Kansas; **David C. Lyons** is a legislative assistant in Washington, D.C.; **Susan E. Miller** resigned; and **Stephen B. Pohl** is with Friendswood Development Company, an Exxon affiliate, Houston, Texas.
Retirement: Ramon B. Wilson, professor, retired in August after 30 years of service.

Texas A&M University

Appointments: James Ahrenholz, Ph.D. University of Missouri, is extension economist-management; **Tom Jones,** Ph.D. Clemson University, is extension agent, area economist-management.

U.S. Department of Agriculture

Reassignments in CED: David W. Culver, formerly with CED, has transferred to FDCD, Washington, D.C.; **Ronald R. Miller,** formerly of CED's Agricultural Policy Analysis Program Area, is with the Department of Energy, Washington, D.C.
Appointments in EDD: Mary Ahearn is with EDD's Health & Education Program Area; **Robert A. Hoppe** was assigned to the Income Studies Program Area, EDD; and **William Serletis** has joined EDD's Housing Program Area, all in Washington, D.C.
Return: Robert Coltrane of EDD's Manpower Program Area, has returned from a year with the National Manpower Commission.
Retirement in FDCD: L. Jay Atkinson has retired from FDCD's Aggregate Demand, Resources, and Policies Area, after 37 years of federal service.
Reassignments in NEAD: Harold Taylor, formerly with NEAD, Philadelphia, recently transferred to NRED, Broomall, Pa.; and **Bruce Wright** has transferred from NEAD's West Lafayette, Indiana, office to CED, Washington, D.C.
Honor: John O. Gerald, NEAD, recently received the U.S. Department of Agriculture's Superior Service Award.
Reassignments in NRED: Lee Christensen, formerly with NRED, Broomall, Pa., recently transferred to NRED, Athens, Ga.; and **Douglas Morris,** formerly with NRED, Durham, N.H., has moved to NRED, Raleigh, N.C.
Resignations in NRED: Robert Niehaus, formerly with the Resource Systems and Program Analysis Group, NRED, has accepted a position at Northeast-Midwest Research Institute, Washington, D.C.; and **Melvin Skold,** formerly with NRED's Resource Inventory and Use Program Area, has joined the Colorado State University staff.
Return: William Crosswhite, former NRED assistant director, has returned from one year at Vanderbilt University.
Appointment in OA: Kenneth R. Farrell has been named administrator of the Economics, Statistics, and Cooperatives Service, USDA.

Virginia Polytechnic Institute and State University

Appointments: Ernest Bentley, Ph.D. Texas A&M, is an assistant professor; **Brady Deaton,** University of Tennessee, is an associate professor.
Retirement: Joseph M. Johnson, professor, retired 31 August after more than 31 years' service.

Washington State University

Appointment: Richard W. Carkner, North Dakota State University Extension Service, is an extension economist in farm business management.

University of Wyoming

Appointment: Harlan G. Hughes, formerly at Michigan State University, is associate professor and coordinator of the Agnet Project.

Other Appointments

Michael K. Bertelsen, Ph.D. Virginia Polytechnic Institute and State University, is an associate professor at the University of Wyoming.
Timothy W. Coats, M.S. University of Missouri, is a commodity analyst with the Pillsbury Corporation, Minneapolis, Minnesota.
Carlos Nayro Coehlo, Ph.D. University of Missouri, is with the Ministry of Agriculture, Brasilia, Brazil.
Ahmed Hussen, Ph.D. Oregon State University, is assistant professor, Resource Economics Department, University of Rhode Island.
R. Terry Keith, M.S. University of Arkansas, is office manager, J-W Operating Company, Magnolia, Arkansas.
Renne D. Nance, M.S. University of Arkansas, is county extension agent, Agriculture for Ashley County at Hamburg, Arkansas.
Enrique Ospina, Ph.D. Texas A&M University, is with the Winrock International Livestock Research and Training Center, Arkansas.
David M. Pullen, M.S. University of Missouri, is president of a firm engaged in highway construction in Cape Girardeau, Missouri.
Charles Riemenschneider, Ph.D. Michigan State University, is on the staff of the Senate Budget Committee with responsibilities for agricultural programs.

Joseph C. Roetheli, Ph.D. University of Missouri, is an agricultural economist with the Tennessee Valley Authority, at Muscle Shoals, Alabama.

Art Smith, Ph.D. Texas A&M University, is with the Cooperative Service, ESCS, USDA, Washington, D.C.

Randall K. Stock, M.S. University of Missouri, is market analyst with the Butler Manufacturing Company, Kansas City, Missouri.

E. Randall Woody, M.S. University of Arkansas, is farm management specialist with the Arkansas Cooperative Extension Service in Hamburg.

Obituaries

L. P. Gabbard

L. P. Gabbard, head of the Department of Agricultural Economics, Texas A&M University, 1946–53, died on 23 June in his ninety-first year. Gabbard was born on 12 March 1888, in Booneville, Kentucky, and started his professional career as a county agent in Tennessee. He went to Texas in 1922 and served as chief of the Division of Farm and Ranch Economics in the Texas Agricultural Experiment Station from February 1926 through October 1946. At that time he became head of the new department of agricultural economics and sociology, serving in that capacity until 1953. He remained on modified service until his retirement in 1958.

Gabbard attended Berea College and received degrees from the University of Tennessee and University of Wisconsin. His major interests were land tenure, taxation, and farm and ranch values. His concern regarding farm foreclosures during the 1930s led to work in tax delinquency on farm real estate. He was one of the pioneer agricultural economists in Texas.

Hugh Bruce Price

Hugh Bruce Price, professor of agricultural economics at the University of Kentucky 1929–59 and a Fellow of the American Agricultural Economics Association, died 6 June in Louisville, Kentucky.

Price was born in Tulare, South Dakota, 21 October 1888. He received an A.B. degree from the University of Wisconsin in 1914, his M.A. degree from the University of Minnesota in 1916, and the Ph.D. from Yale University in 1921.

He joined the staff of the University of Minnesota in 1921 as professor of agricultural economics. It was here that he developed an interest in agricultural marketing and wrote his pioneer text, *The Marketing of Farm Products*. He also collaborated with John D. Black in studies of centralized cooperative marketing organizations.

In 1929, Dr. Price became professor of agricultural marketing and head of the Department of Markets and Rural Finance, University of Kentucky. He continued as head until 1946. He contributed to research on tobacco and helped several farm organizations develop tobacco policy and programs.

Price became acting head of the Department of Agronomy during a period of reorganization, later moving into administration of the Kentucky Agricultural Experiment Station where he was acting dean and director. He retired from the University in 1959 as professor emeritus.

He was vice president of the American Farm Economics Association in 1938 and president in 1940. He served as editor of the *Journal of Farm Economics* from 1942 to 1949 and was elected AAEA Fellow in 1962.

Anthony S. Rojko

Anthony S. Rojko, USDA agricultural economist, died 27 June in Washington, D.C. Prior to his death, he served as leader of the Commodities Program Area of the Foreign Demand and Competition Division, ESCS, where he authored or coauthored numerous USDA publications, among them *World Food Situation and Prospects to 1985*, published in 1974 for the World Food Conference.

Rojko earned his B.A. in agricultural economics from the University of Connecticut and did graduate work at the University of Chicago. He started his government career with the Bureau of Agricultural Economics, Boston, in 1948. Later, he headed the Price Research and Methods Section of the Economic and Statistical Analysis Division, ERS, in Washington, D.C.

Rojko is survived by his wife, Genevieve, five daughters, and one son.

George Bruington Whitman

George Bruington Whitman died 19 December 1977. He retired from the University of Illinois in 1961, after a long career in the Cooperative Extension Service at both county and university levels.

Whitman served with the U.S. Navy during World War I and received a B.S. degree from the University of Illinois in 1920. He farmed in Warren County 1920–33.

In 1934 Whitman became farm adviser with the Illinois Cooperative Extension Service in Henderson County, then moved to Adams County in 1938. He helped promote formation of the Illinois REA cooperative and also to organize marketing cooperatives for grain and livestock, as well as frozen food lockers. He helped establish county 4-H fairs and corn husking contests in the 1930s.

Whitman joined the state extension staff in 1946 and then moved to the Department of Agricultural Economics in 1948 as extension specialist. His primary interest became income tax training for farmers and tax preparation professionals. He helped organize the annual tax conference between state and USDA extension personnel and the Internal Revenue Service taxpayer education staff. Those conferences resulted in publication of the *Farmer's Tax Guide*. He also was a state project leader of the simplified farm accounting program and helped revise the Illinois farm record book. In 1959 he helped start *Economics for Agriculture*, a publication series for county extension staff, and served as editor of the newsletter, *Farm Management Facts and Opinions*, from 1953 until his retirement.

NEW BOOKS on POPULATION
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For The International Union for the Scientific Study of Population

The International Union for the Scientific Study of Population (IUSSP) is a non-profit, scientific organisation composed of individual members. Established in 1928, it strives to stimulate research on population, develop interest in demographic matters, foster relations between people involved in population studies and disseminate scientific knowledge on population. It has consultative status with the Economic and Social Council of the United Nations and with UNESCO.

POPULATION GROWTH AND ECONOMIC DEVELOPMENT IN THE THIRD WORLD

"... we should be grateful to Léon Tabah and his colleages for all the valuable work assembled here ...". R. Cassen - People.

In recent years population growth has become a prime concern of contemporary society. Because it is held accountable for or at least associated with almost every problem of today's world - be it economic or environmental, political or psychological - it has been the subject of a series of international meetings, at first convened regionally and finally culminating in 1974 with the United Nations World Population Conference. These twenty-one authoritative studies convering a broad range of specializations are basic to an understanding of the new spirit expressed in Bucharest when the Conference adopted a world plan of action to support programs relating population policy to development. Although the authors focus their discussion on the "Third World", it is clear that the interdependence of the economies of developing and developed countries and the increasing homogeneity of human experience give their findings and conclusions universal significance.

Here the reader will find a balanced approach to a broad development strategy which must include population planning. Granted that population pressures have been known to stimulate innovation and progress, no country can afford a long period of unchecked population growth. The various chapters present a brilliant panorama of how these pressures influence the functioning of society migration from rural to urban areas, as well as between countries, in search of employment; family-size decisions reflecting a change in the perception of family welfare; educational reforms to meet the needs of an ever-expanding youth population; agricultural techniques to improve or open up sources of food supply; more economic patterns of human reproduction responding to the medical advances that have so dramatically lowered infant mortality.

The authors do not speak from an academic tower or a political forum. To the contrary, they have made their topics an integral part of the social fabric, recognizing that the differences in conditions and potentials between countries do not permit generalizations or simplifications. Thus, critical consideration is given to such issues as the "Green Revolution" in agriculture, the responsibility of health care in the population explosion the determinants of growth of the labor force, women as a factor in the labor supply, the depletion of natural resources and damage to the environment, the effect of population growth on aggregate savings, and the value of prevented births for the family and the national economy.

While the chapters applying demographic models and quantitative analysis to the economics of population growth will be of special interest to those who are professionally involved, the book as a whole will provide the general public with valuable insights into key aspects of population and development.

Edited by Léon Tabah
1976 - 2 vols - 820 pages - Hardback
1,400 Belg. fr. (US $ 45)
Ref. UE.08

OTHER TITLES

MEASURING THE EFFECT OF FAMILY PLANNING PROGRAMS ON FERTILITY. Edited by C. Chandrasekaran and A.I. Hermalin.
1976 - 570 pages - Hardback
960 Belg.fr. (US $ 30) Ref. UE.09

LAW AND FERTILITY IN EUROPE. Edited by M. Kirk, M. Livi-Bacci and E. Szabady.
1975 - 2 vols - 698 pages - Hardback
1,200 Belg. fr. (US $ 38) Ref. UE.05

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1971
D. Howard Doane
Don Paarlberg
Rainer Schickele

1972
Karl A. Fox

1973
Harold F. Breimyer
Kenneth H. Parsons
Lauren K. Soth

1974
Dale E. Hathaway
Vernon W. Ruttan
John F. Timmons

1975
Geoffrey S. Shepherd
S. V. Ciriacy-Wantrup
Holbrook Working

1976
Emery N. Castle
Arthur T. Mosher
Willard F. Mueller

1977
Lowell S. Hardin
Austin C. Hoffman
Sidney S. Hoos
Earl R. Swanson

1978
Chester B. Baker
James T. Bonnen
Richard A. King
Lawrence W. Witt

Chester B. Baker

1978 Fellow

Professor, Department of Agricultural Economics, University of Illinois, 1957 to date; currently group leader in agricultural finance.

Professor, Department of Agricultural Economics, Montana State University, 1951–56.

General chairman, AAEA Awards Committee, 1970–72.

Member, Executive Board, American Agricultural Economics Association, 1973–75.

Ernest H. Wakefield Award, 1975, Paul A. Funk Award, 1976, University of Illinois.

Chester B. Baker has increased the rigor and logic of the approach to problems of agricultural finance. This is a major contribution to the profession of agricultural economics. His integration of financial, marketing, and production decision processes has brought agricultural finance into the main body of applied agricultural economics by expanding its theoretical foundation. His contribution has facilitated a more comprehensive and unified view of farm management and marketing. Baker was at the forefront of those few agricultural economists who anticipated the shift in management emphasis from enterprise choice to finance; fortunately, he forged the improved tools with which the needed analyses could be made.

A native of Iowa, Baker received his B.S. degree with highest honors from Iowa State University. He completed his Ph.D. at the University of California, Berkeley, and began his professional career at Montana State University before joining the Department of Agricultural Economics at the University of Illinois in 1957.

To label Professor Baker as a specialist in agricultural finance does not accurately portray his range of capabilities. Since his early career at Montana State, he has had an interest in the agricultural research process itself. This led to the initiation and development of a graduate course in research methodology, a course highly popular with students regardless of their areas of specialization.

Over the years, Baker has trained an able cadre of graduate students who are emerging as leaders in agricultural finance and in other areas. Two of his students have received Association awards for doctoral dissertations. Although demanding, he is clearly a most popular advisor to graduate students.

Baker's subject matter contributions have been widespread. During the last few years he has added substantially to public understanding of world food problems through various writings and lectures. In 1976 he served on the Study Team on World Food and Nutrition for the National Academy of Sciences.

His work also has a substantial international dimension. He contributed to AID's *Spring Review of Small Farm Credit* in 1973, and to seminars sponsored by the Agricultural Development Council. He has been consultant to Australia's Industries Assistance Commission, to the Task Force on Canadian Agriculture, to the Ford Foundation in India, and to US/AID in Thailand. In addition, he has been a visiting professor at the University of Guelph, the University of Sydney, the University of Melbourne, and a visiting lecturer in several foreign universities.

James T. Bonnen

1978 Fellow

Professor, Department of Agricultural Economics, Michigan State University, 1954–present.
American Farm Economics Association award for outstanding Ph.D. thesis, 1957.
Senior staff economist, President's Council of Economic Advisors, 1963–65.
Award for the outstanding article published in the *Journal of Farm Economics,* 1965.
Member, President's National Advisory Commission on Rural Poverty, 1966–67.
Distinguished Faculty Award, Michigan State University, 1972.
President, American Agricultural Economics Association, 1975–76.
Chairman, AAEA Economic Statistics Committee 1969–74, and Joint Advisory Committee on Agricultural Statistics of the AAEA, AEA, and ASA, 1970–74.

James T. Bonnen is a discerning observer of political processes affecting American agriculture, and an insightful analyst of public policies, institutions, and organizations that constitute the U.S. agricultural establishment. His major research interests have included commercial agricultural policy regarding excess productive capacity, the distributional consequences of commodity programs, rural poverty, the USDA-Land Grant College System, agricultural information systems, and the role of the university in public affairs.

Bonnen was born in South Dakota but spent most of his early years at College Station, Texas, where his father served as a professor of agricultural economics at Texas A&M University. He received a B.A. in economics at Texas A&M and his M.A. at Duke University. Bonnen's Ph.D. work was done at Harvard University, where John D. Black stimulated his interests in institutional and organizational problems facing American agriculture.

James Bonnen joined the faculty of the Department of Agricultural Economics at Michigan State University in 1954. Within the department he has been an active teacher, productive researcher, and a colleague who is often sought for professional counsel. He has served on numerous committees in college and university academic governance. For two years, 1972–74, he chaired the faculty steering committee, a committee which is the hub of university academic governance.

Among other awards and honors which have been bestowed on Bonnen are the AAEA Award for Outstanding Doctoral Thesis in

1957 and the Award for the Outstanding Article in the *Journal of Farm Economics* in 1965. In 1972 Michigan State University presented him its Distinguished Faculty Award.

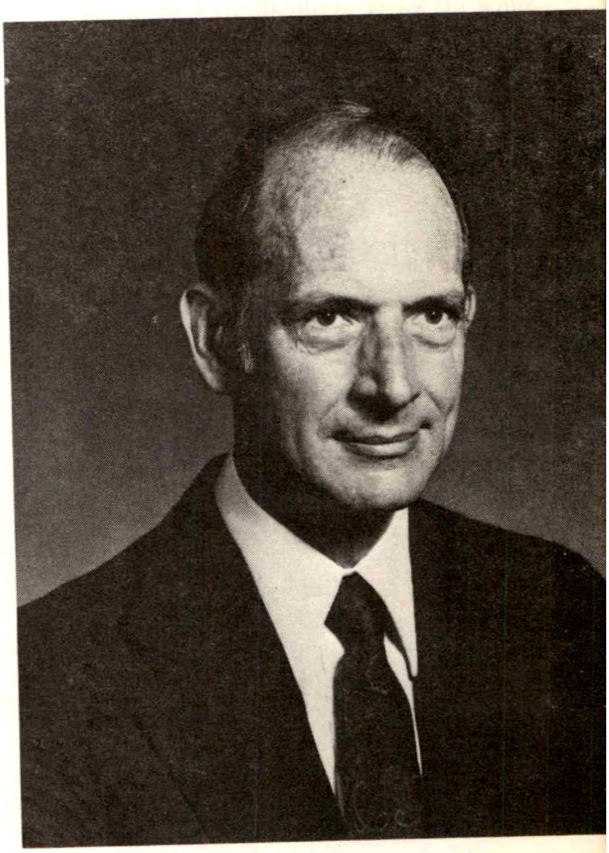
Bonnen has been an active consultant to industry, government, and foundations. He has served on the National Advisory Committee to the Institute for Research on Poverty, on the editorial board of the *Journal of Social Indicators Research,* and as consultant to the Bureau of the Budget and the Council of Economic Advisors.

During the period August 1963 to July 1965 Bonnen served as senior staff economist with the President's Council of Economic Advisors. He was on the Presidential Task Force on Agriculture in 1964 and was appointed by President Johnson as a member of the National Advisory Commission on Rural Poverty in 1966–67.

James Bonnen has been a leader in efforts by our profession to bring about improvements in the agricultural statistical system. During the early 1970s he concurrently served as chairman of the AAEA Economic Statistics Committee and the Joint Advisory Committee on Agricultural Statistics of the American Agricultural Economics Association and the American Statistical Association. When installed as President of the AAEA in 1975, Bonnen delivered his presidential address on "Improving Information on Agriculture and Rural Life." In 1978 he was called to Washington to head the President's reorganization project for the Federal Statistical System.

Richard A. King

1978 Fellow



M.G. Mann Professor of Economics and Business, North Carolina State University.

Former president, Southern Agricultural Economics Association.

Visiting professor; University of Virginia, Universidad Agraria (Lima, Peru), University of California at Berkeley, North Carolina Agricultural and Technical State University, and the USDA.

Elected to Academy of Outstanding Teachers in 1967, Certificate of Merit, NCSU Chapter of Gamma Sigma Delta in 1975.

Consultant to the Research Triangle Institute, the Ford Foundation, USAID, and the Council on Wage and Price Stability.

Editorial Council, *American Journal of Agricultural Economics,* 1955–57.

Chairman: Employment Committee, 1958–61; M.S. Thesis Awards Committee, 1961–63; International Activities Committee, 1967–70, American Agricultural Economics Association.

Richard A. King has achieved recognition at home and abroad for his outstanding teaching and research, particularly for his empirical research which has linked him with research and extension colleagues in many of the agricultural sciences and with policy makers.

Born in Massachusetts in 1922, he completed his B.S. at the University of Connecticut, his M.S. at the University of California, Berkeley, and his M.P.A. and Ph.D. degrees at Harvard University. He joined the faculty of the University of Connecticut in 1948, and in 1951 moved to North Carolina State University where he was named M.G. Mann Professor in 1957. His career has included a post-doctoral year at the University of Chicago in 1955–56, visiting professorships at the University of Virginia, the University of California, Berkeley, North Carolina A&T State University, the Universidad Agraria in Lima, Peru, and an assignment with the U.S. Department of Agriculture. He has served as advisor to the U.S. Department of Agriculture and the executive office of the president.

Professor King has served the American Agricultural Economics Association long and well, including chairing of the Employment, M.S. Thesis Award, and International Committees. Recently he completed a term as president of the Southern Agricultural Economics Association. His service and professional achievements have been acknowledged by the members of this association, who have elected him to be president for 1979–80.

At North Carolina State University, Professor King has served on many important university committees. In recognition of his efforts, the students have named him one of the university's outstanding teachers. He has chaired graduate committees for scores of students, and a measure of his success can be seen in the outstanding contributions of these former students to our profession.

Professor King was among the first to apply activity analysis to agricultural problems. Since his early application of linear programming to farming situations, he has been a leader in applying programming methodology to more general agricultural and economic development problems. His contributions relative to the space and time dimensions of economic analysis have been widely referenced. A major contribution to this area of study is the book he co-authored, *Markets, Prices and Interregional Trade*.

Lawrence W. Witt

1978 Fellow

- Professor, Department of Agricultural Economics, Michigan State University, 1947–73.
- Distinguished Faculty Award, Michigan State University, 1967.
- Book Review Editor, 1949–51, Editor, 1952–54, *Journal of Farm Economics.*
- President, 1967; vice-president, 1956, American Agricultural Economics Association.
- Meritorious Honor Award, U.S. Department of State, while serving as agricultural economist in the Bureau of Intelligence and Research, 1976.

Lawrence W. Witt has had a long and distinguished career as a teacher, researcher, and advisor in the areas of agricultural policy, international trade, and agricultural development. He was born in Wisconsin and educated at the B.S. level at the University of Wisconsin. He obtained M.S. and Ph.D. degrees from Iowa State University. He joined the faculty of Michigan State University in 1947, where he played a major role in the growth and development of the Department of Agricultural Economics over a twenty-five-year period. Professor Witt also played an important role in the development of a strong international dimension at Michigan State University. In 1959 he prepared a major policy document outlining an operational framework for the University's Office of International Studies and Programs. In 1967 Professor Witt was honored with a Distinguished Faculty Award in recognition of his outstanding performance as a teacher and researcher at Michigan State University.

Lawrence Witt has been an active leader and contributor to the activities of the American Agricultural Economics Association. He served as book review editor for 1949–51, was editor of the *Journal of Farm Economics,* 1952–54. He was elected vice-president of the association in 1956 and president in 1966. As association president he initiated significant changes in the organization and administration of association activities. He also has been an active member of the American Economics Association and played a leadership role in the

Institute for Current World Affairs and the American Universities Field Staff.

Professor Witt has authored a long list of bulletins and articles and has made significant contributions to six books on trade, economic development, and marketing. In the early 1960s he carried out major research on the effects of U.S. agricultural surplus disposal programs on recipient countries and developed a comprehensive publication outlining a program of research on the use of food for peace.

Professor Witt has been a frequent consultant to government agencies, both foreign and domestic, and to international development organizations, including FAO, the Inter-American Development Bank, the U.S. Agency for International Development, the National Research Council, the National Planning Association, and the Ford Foundation. He also has been called on to testify before congressional committees on agricultural policy issues, especially in the area of international trade. In December 1973, Professor Witt elected to take an early retirement from Michigan State University to accept a high-level staff position in the U.S. Department of State where his knowledge and analytical skills are providing inputs into policy decisions on agricultural trade, world food problems, and related development issues.

Presidents, 1910–79

1910–12
William J. Spillman

1913
George F. Warren

1914
Daniel H. Otis

1915
Andrew Boss

1916
Harcourt A. Morgan

1917
Henry W. Jeffers

1918
George A. Billings

1919
John R. Fain

1920
Henry C. Taylor

1921
Walter F. Handschin

1922
Benjamin H. Hibbard

1923
Thomas P. Cooper

1924
Edwin G. Nourse

1925
Milburn L. Wilson

1926
Thomas N. Carver

1927
John I. Falconer

1928
Lewis C. Gray

1929
H. E. Erdman

1930
Harold C. M. Case

1931
Oscar C. Stine

1932
John D. Black

1933
Howard R. Tolley

1934
William I. Meyers

1935
Waldo E. Grimes

1936
Joseph S. Davis

1937
Oscar B. Jesness

1938
Ernest C. Young

1939
Irving G. Davis
Foster F. Elliott

1940
Hugh B. Price

1941
Murray R. Benedict

1942
George S. Wehrwein

1943
Sherman E. Johnson

1944
Eric Englund

1945
Lawrence J. Norton

1946
Frederick V. Waugh

1947
Asher Hobson

1948
William G. Murray

1949
Oris V. Wells

1950
Warren C. Waite

1951
Forrest F. Hill

1952
George H. Aull

1953
Harry R. Wellman

1954
Thomas K. Cowden

1955
Joseph Ackerman

1956
Karl Brandt

1957
H. Brooks James

1958
Harry C. Trelogan

1959
Raymond G. Bressler, Jr.

1960
Willard W. Cochrane

1961
William H. Nicholls

1962
Bushrod W. Allin

1963
George E. Brandow

1964
Lowell S. Hardin

1965
D. Gale Johnson

1966
Kenneth L. Bachman

1967
Lawrence W. Witt

1968
C. E. Bishop

1969
Harold F. Breimyer

1970
Dale E. Hathaway

1971
Jimmye S. Hillman

1972
Vernon W. Ruttan

1973
Emery N. Castle

1974
Kenneth R. Tefertiller

1975
James Nielson

1976
James T. Bonnen

1977
Kenneth R. Farrell

1978
R. J. Hildreth

1979
Bernard F. Stanton

Bernard F. Stanton

1978–79 President

Professor, Department of Agricultural Economics, Cornell University, 1954–present; department chairman, 1968–76.

Director, American Agricultural Economics Association, 1974–77; Finance Committee chairman, 1975–77; Awards general chairman, 1973–75; Editorial Council, 1958–62.

Director, Fund for International Association of Agricultural Economists, 1970–present; vice-president, 1973–present.

Bernard F. Stanton is a professor of agricultural economics at Cornell University and former chairman of that department (1968–76). His primary work is in production economics and farm management. He currently teaches courses in linear programming and research methodology.

Stanton was born on a dairy farm in Albany County, New York. He farmed with his brother for three years after high school and then enrolled as a student in the New York State College of Agriculture, Cornell University. He graduated with a B.S. in 1949 and was class president his senior year. He completed his M.S. in agricultural economics at the University of Minnesota in 1950 and was granted the Leonard Elmhirst Studentship for a year's study at the Agricultural Economics Research Institute, Oxford University in 1950–51. He returned to the University of Minnesota to complete his Ph.D. under the direction of Dr. George Pond, with a major in farm management. While completing his doctoral program, 1951–53, he was an instructor at the University of Minnesota, in the two-year School of Agriculture.

Stanton joined the faculty in agricultural economics at Cornell University in October 1953. At Cornell, Stanton has held a joint appointment in extension, teaching, and research. He taught an introductory course in statistics for twelve years, as well as courses in production economics and research methods. He has served on a wide range of college and university committees including the Faculty Council of Representatives.

Stanton spent his first sabbatic leave as an economic statistician working with Cavin and Royko at the USDA in 1960. He was a Fulbright Research Scholar at the University of Helsinki, Finland, 1966–67. He was a visiting fellow at the Research School of Pacific Studies, Australian National University, Canberra, during the spring of 1976 and visiting professor at Tamil Nadu Agricultural University, Coimbatore, India, in the fall of 1976. He also has served as consultant and lecturer for the Economic Development Institute of the World Bank.

An important component of Stanton's interest in agriculture and rural issues stems from his participation in 4-H Club programs at the local, state, and national level. He looks on his active role in the development of the First International Farm Youth Exchange Program (IFYE) as one of the highlights of his career.

He is married to the former Lara Kristjanson from Mountain, North Dakota. They have three children and live in Ithaca, New York.

General Sessions

Perspective on Farm Size

B. F. Stanton

Farm size has been on the agenda of meetings of agricultural economists in this country from the beginnings of our profession. At times it has been a central issue and has been given high priority. At others it has played a secondary role, but it has seldom stayed completely in the background. Most agricultural economists, regardless of specialized interests, such as quantitative methods or market structure, have expressed opinions on this subject. Often these opinions reflect a mixture of emotion and objective judgment.

One might well ask why farm size has continued to be of interest to so many for so long. I think there is an important mixture of reasons. One relates to poverty in rural areas, low incomes, and a desire to insure some minimum level of living for farm people. A second has to do with business management—finding combinations of resources that are productive and then discovering ways to combine them successfully on individual farms. A third, closely related reason has to do with efficiency—what is the least cost or the best way to use a given bundle of resources, not only on individual farm units but across whole groups of farms? A fourth is concerned with distribution—who is it that controls our land and agricultural resources and how broadly or narrowly are these resources distributed amongst farmers and others?

Farm size is clearly a policy issue. At one level the focus of concern is on individual farmers and their welfare. At another it centers on society as a whole and such questions as who gains and who loses with changes in farm structure over time, and how much power is concentrated in the hands of how many?

The pioneers in what came to be known as agricultural economics in this country came from a variety of disciplines and backgrounds (Taylor and Taylor). Most were drawn to this field because of a concern for the low incomes of farmers. They sought to learn why some farmers did better than others. Farm size was quickly identified as one of the key issues. The farm business as a unit and farm management decisions were targets of primary attention (Case and Williams).

Today farm size questions continue to be examined from somewhat conflicting vantage points within our discipline. Some of us concentrate on the individual unit, seeking ways to encourage firm growth, mechanisms to accumulate and retain capital, and pointing out means to avoid tax burdens through estate planning. At the same time others are concerned with the policy implications of concentration of farm production in the hands of fewer farms and the potential for an industrialized organization of agriculture. At our winter meetings, the title of one session was "Appropriate Technology for U.S. Agriculture: Are Small Farms the Coming Thing?" (Doering, Gardner and Pope, Raup 1978, Barkley). Two of the invited paper sessions at this meeting concern size issues: "Impact of Public Policy on the Control of Agricultural Resources" and "Consequences of Acreage Limitation and Other Provisions of the Federal Reclamation Law."

A reexamination of size issues seems in order. The pioneers in our field saw the need to define farm size along with many other basic concepts as topics for study. Many of the insights we take for granted in textbooks, bulletins, articles, and classroom lectures stem from their careful and much debated work. To provide perspective, I would like to examine our collective efforts over the years to study the economies and diseconomies of size, particularly now that there appears to be substan-

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Presidential address.

B. F. Stanton is a professor of agricultural economics, Cornell University.

This paper reflects some of the things I have learned and observed from farmers, agricultural businessmen, students, and colleagues. Ken Farrell, Jim Hildreth, and Phil Raup took time to provide new insights on early drafts of the paper. Many colleagues at Cornell helped, especially C. A. Bratton, N. Bills, G. Casler, H. Conklin, L. Day, O. Forker, R. B. How, K. Robinson, D. Sisler, R. Smith, and R. Stavins, by providing detailed comments and helpful criticisms. I am particularly grateful to Stan Warren for his encouragement to work in farm management. Bill Tomek improved both the content and the final presentation. Cherie Morse patiently typed the drafts and put the final copy in good form. Errors of fact and judgment rest with the author.

tial public interest in controlling or limiting farm size. Finally, we need to think more about the consequences of different possible distributions of farm sizes and what they may mean to farming and people in relation to other sectors of the economy in an industrialized, urban society.

Historical Perspective

It is important to pause and note our professional roots, which are less than 100 years old. Few graduate students or young agricultural economists today identify with names like John D. Black, Andrew Boss, Thomas Nixon Carver, G. F. Forster, William J. Spillman, Henry C. Taylor, or George F. Warren. Yet it is likely that all would have been named fellows of this association had they been living when the first ten were named in 1957. Black, Carver, and Taylor came to this field out of economics. Boss, Forster, Spillman, and Warren came from technical agriculture.

By 1915 there were already five important textbooks written from somewhat different perspectives dealing with farm management and agricultural economics: H. C. Taylor, *Introduction to the Study of Agricultural Economics* (1905); T. F. Hunt, *How to Choose a Farm* (1906); T. N. Carver, *Principles of Rural Economics* (1911); G. F. Warren, *Farm Management* (1913); and Andrew Boss, *Farm Management* (1914).

The *Journal of Farm Economics* started publication in June 1919, at the time the American Farm Economic Association was founded by merger of the American Farm Management Association (1910) and the National Association of Agricultural Economists (1915) (Taylor, 1922).

Defining concepts and then finding ways to measure and quantify them received substantial attention from the beginning. For example, one of the more interesting definitions of a farm was included in a Report of the Terminology Committee, published in the *Journal* in 1919. A farm was defined as "a property composed of a single tract or separate tracts of land equipped as a unit for agricultural production and which raises products equivalent in value to at least the wages of a hired man" (Dadisman, Arnold, Branch, pp. 76–77). This definition is unique in that it sets a lower limit for farm size in terms of output with a built-in mechanism for adjustment as farm wage rates change.

Role of Management

The key role of the farmer and his family in determining farm size, in the efficiency of resource use, and the structure of agriculture was recognized and debated in many of the early writings. Taylor (1905) stated, "While there is no one proper size for farms in general, there is always a proper size of farm for a given man, at a given stage of his own development, on a given type of soil in a given line of production with given labor and market conditions" (p. 155).

Warren puts less emphasis on the individual. In contrast is this statement, "Some persons believe that there are 40-acre farmers, 80-acre farmers, and 300-acre farmers, and that all these men have so shifted around that the larger farms are always in the hands of the better men. The better results are, therefore, all attributed to the man. A study of the history of a large number of individual farms and farmers shows that the man is only one of the many factors that have to do with success" (p. 263).

These statements provide a little of the flavor of the debate. Today we give more emphasis to individual entrepreneurship and management as a contributor to success than did Warren and somewhat less than did Taylor.

Measures of Size and Capacity

Consider another way in which early efforts by the pioneers are reflected in today's research and teaching. Measuring the size of a business, both for descriptive purposes and for further analysis, is not straightforward. Most of us use both output and input measures when we talk about size of farms. A key resource or input like labor leads us to talk in terms of one– or two–man farms. Where crops are dominant, 160- or 640-acre farms may be most descriptive. In livestock areas we are more apt to talk about 100 cow dairies or 30,000 bird laying flocks. All of these are input measures where one key resource is central in our descriptions.

Output measures, like gross farm sales, provide a way of describing multiple enterprise businesses and making comparisons across types of farms and with other nonfarm businesses. Value of farm sales is widely used as the basis for classifying farms in the Census and most other national statistical series. But there are problems with such output measures. A feedlot operation, which buys feeders and most other inputs, has a much smaller value-added component relative to total sales than does a cow-calf operation that supplies the feeders to the feedlot. John D. Black was a key figure in helping us understand this point. He discussed the concepts of capacity, efficiency, and productivity as well as measures of size in his widely used text of fifty years ago, *Production Economics*.

> The true capacity of each of the elements in the producing units is measured in terms of its inputs at economic capacity. But what we here wish to measure is the capacity of *all* the elements making up the producing unit—of the variable inputs as well as the fixed inputs, and to measure all of them in one measure. Since all these different inputs are expressed in terms of each other, there is no way of combining them. A perfect measure of size is therefore impossible of attainment. . . . What is actually done is to choose that measure of size for each industry which is workable and at the same time comes nearest to meeting the requirements of an ideal measure. In general, those measures which are in terms of inputs, or which measure the fixed plant in physical terms, really come nearer to being good measures of size than those measured in volume of output (pp. 540–41).

The concept of capacity is given less attention today than was the case between 1925 and 1955, perhaps because the definition remains somewhat abstract. If one applies this idea to a producing unit like a farm, it is analogous to the inherent ability of the fixed plant or committed resources of land, management, and capital to absorb or use other inputs in production. Different producing units, including both the farm and the farmer, have different inherent capacities.[1] And, in turn, the way in which these resources are used in production determines both output and efficiency. When performance of any business unit is evaluated, some effort to recognize and measure the inherent capacity of resources like cropland, livestock, or machinery for a given level of technology can help us do a better job of explaining the results obtained in either a positive or normative framework. In an analytical context, measuring capacity is the key element in understanding size and differential output of farms.

Ownership Issues

Some questions asked more than fifty years ago in the *Journal* are still topical today. "Who Owns the Agricultural Land in the United States?" was the question posed in 1922 by George Wehrwein and then discussed further by C. L. Stewart. There was substantial concern then about items that are current issues in 1978. In his article Wehrwein indicated, "The study of the large land holdings of the eight southern counties of California made in 1919 shows that outside of railroad and public land one half of the land area was owned by 250 individuals and corporations . . ." (p. 40). He concluded, however, that "the problems of concentration of ownership, absentee and alien ownership, the ownership of land by low standard nationalities and tenancy are highly local in character . . ." (p. 41). Land economists, as they were called thirty years ago, or resource economists as we know them today, generally have recognized and incorporated the work of early scholars into their writing and research as well as any group in our profession. More of us might benefit from their excellent example in studying contemporary problems.

Economies and Diseconomies of Size

Agricultural economists have given much more emphasis to economies of size and scale[2] than to diseconomies. We have been quick to identify and demonstrate processes whereby fixed costs are reduced as they are spread over more and more units of output. Jacob Viner's formulation of the theory and concepts underlying the long-run average cost curve has been widely accepted. His original statement and its subsequent revisions have become the basic theoretical model used throughout the western world. Many engineering, budgeting, and linear programming studies exist for different types of farms, processing plants, and producing units (Carter and Dean; Faris; Howell; Hubele et al.; Kohout and Headley; Ottoson and Epp). Most of these identified least-cost, technically efficient, producing systems for specified states of technology. Very often such studies suggest that after per unit costs reach a low point on the long-run average cost curve, they continue at this level over quite a wide range of production capacities. Over this range, marginal cost must equal average cost per unit. Diseconomies do not set in, and the long-run average cost curve appears to be essentially flat. It has been easier to identify what makes this cost curve fall than to discover evidence or demonstrate economic logic that shows long-run costs rising after some point.

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[1] One of the clearest expositions of capacity as a concept is presented by C. L. Holmes (chap. 12). He was a student of H. C. Taylor and was professor and head of the Department of Agricultural Economics, Iowa State University. Black also acknowledges Taylor as an early source of his ideas on capacity and efficiency.

[2] The expression "economies of size" and "economies of scale" have been used almost interchangeably by some economists. Technical scale relationships imply constant factor proportions which are almost impossible to achieve in the real world. Hence, economies of size is the more widely used and more appropriate term.

Reviews of Studies

One of the best reviews and statements on economies of size in farming is Madden's 1967 study. He reviewed the theoretical basis for carrying out applied studies on economies of size, discussed methods used in such analyses, and summarized a sampling of empirical studies in fourteen different situations including crop farms as well as dairy and beef feedlots over the period 1950–65. A few of his summary statements bear repeating:

> A number of studies of crop-farming situations in various States were reviewed. In most of these situations, all of the economies of size could be achieved by modern and fully mechanized 1-man or 2-man farms.[3] (p. ii)
>
> In many areas and for many types of farming, the most rapid increase in number of farms is in the intermediate size classes, consisting chiefly of farms that can be operated by one or at most only a few full-time men, using modern technology and adequate capital. The number of very large farms seems to be increasing only gradually and, in some cases, to be decreasing. (p. 7)
>
> The approach used here is to refine the concepts underlying the traditional theory to allow for the treatment of uncertainty and difficulty of coordination as factors limiting indefinite expansion of farm size. (p. 8)

More recently French has provided a comprehensive review of studies on economies of size and productive efficiency for firms throughout the agricultural marketing system including activities at each stage starting with farm production and moving through assembly and distribution. This review and especially table 3, "Economies of Scale in Agricultural Marketing Plants: A Summary of Findings in Selected Studies, 1950–74," will be an important source and citation in agricultural economics research for years to come. French concludes after his own careful review of the ninety-eight studies summarized in this table:

> The widespread existence of economies of scale, with the largest plant almost always showing the least cost, is clearly an important force in shaping the future development of the marketing system. In dealing with the specific implications of these findings, however, it is important to recognize that scale is only one of several factors affecting the level of plant cost. The modern scale curves are standardized for operating and abstract from the real-world concern with uncertainty and change. Moreover, they all pertain only to plants, not firms, and thus reveal little about possible advantages or disadvantages for multiplant firms. (p. 151)

Most of the analyses cited by French are based on budget comparisons developed from some combination of engineering and technical cost data, and established for a given set of production technologies and market conditions. Most of these studies have not considered carefully the question of possible diseconomies of size as output continues to increase. Because these models cannot be tested in the field except when a firm or individual uses the results in making an investment decision, the results must be verified largely by logic, and by examining the methodology and assumptions of the models.

Survivorship

Most of us subconsciously use a variant of Stigler's survivorship technique in examining economies of size: "It is based on the hypothesis that plant sizes which are efficient will survive and plant sizes which are inefficient will decline" (French, p. 132). We constantly look at changes which have occurred, which are observed currently, and project these into the future. This approach was formalized by Stigler using data from the census and has been subject to a variety of criticisms well summarized by Madden and by French. Some of the logic behind the concept of survivorship is appealing. Successively larger and larger firms survive in some cases, but not in others. Commercial farms remain small in comparison to firms in other industries in most of the western world. It is natural to assume there are inherent reasons for this phenomenon which can and should be widely recognized. While some are institutional in origin, there must be important economic reasons as well.

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[3] This is the basic hypothesis verified with more recent data by Bailey.

Limits to Size

Heady and his students have considered the relatively neglected question of limits to farm size as carefully as any group during the past twenty-five years (Heady and Gibbons; Heady and Krenz; Ihnen and Heady; Jensen; Madden). In his basic textbook, Heady concludes his chapter on "Returns to Scale and Farm Size" as follows: "The optimum size will differ between farms depending on the stock of labor and management possessed in the household of each and it will need not result in the most efficient use of a nation's resources. . . . It is doubtful that cost economies are great enough in most segments of American agriculture to endanger the units typically operated by farm families" (p. 380).

Underlying much of this discussion is a basic philosophy widely held in our profession: "Continuance of the so-called family farm as the main structure of agriculture suggests, on the one hand, that if size economies exist, they soon give way to diseconomies. Concurrently, the continuance of small farms suggests the hypothesis that the economic dynamics of risk and uncertainty may be the final determinant of farm size in agriculture" (p. 350).

What are the internal and external diseconomies that limit or discourage growth in farm size? Some have just been suggested by Heady. The management resource is commonly cited as limiting. Risk and uncertainty with respect to weather, the timing of operations, prices, diseases, pests, and other natural hazards require crucial decisions at the site of operations. The processes of labor management and supervision, the overview of production operations over large physical areas, and the exercise of control in a biological context on one hand and financial on the other establish limits for most managers. Costs of assembly and distribution over ever larger areas, increasing costs because of sanitation problems, disposal of waste products, and similar issues associated with concentration of production are other reasons for diseconomies to appear. And, as Brewster pointed out so clearly in his award-winning *Journal* article of 1950, most farming operations do not lend themselves to the advantages of routine specialization in the assembly line style of the industrial mode. Cage layer operations and "broiler factories" are still more the exception than the rule in commercial agriculture.

It is difficult to recognize explicitly and specify the nature of diseconomies in a budgeting or economic engineering model. The technical data and cost functions are simply not available to describe the rates at which either yields decline or costs increase when important diseconomies do exist. In the Lake states and Northeast, where more than half of the nation's dairy cows are found, 1,000 cow-producing units are almost nonexistent and the number of farms with 500 cows or more is small. The logic of survivorship is rather clear: some combination of technical relations and constraints limit the ability of most able young entrepreneurs to expand much beyond 300 milking cows given current knowledge, technology, and institutions. We know something about these limits in a qualitative sense, but much less than on the cost economies side. In this setting, the models are tested by farmer experience as well as logic. Simulating problems of expansion and trying to establish the reasons for cost increases or constraints to added capacity requires coefficients that are not available.

As a profession we have a good record of documenting and studying successful expansions of farm businesses and the process of growth (Baker et al.; Hawthorne; Harris and Nehring; Krause and Kyle; Patrick and Eisgruber; Shepherd). We have been less imaginative in trying to examine large farms that failed and the reasons that led to their decline, even for much heralded innovations like the cow pool concept of twenty years ago (Wolf; Braun).

Specifying Diseconomics

Heady and Krenz attempted to quantify diseconomies and describe increasing unit costs associated with untimeliness of operations in a study of machine technology in Iowa in the early 1960s. They looked at alternative combinations of tractors and crop equipment of differing capacities for crop and livestock farms on two different soil associations. The following extract summarizes their approach:

> The only factor considered in this study which can result in rising per-unit costs and thus limit the expansion of farm size is the untimeliness element of field operations. No other factors are included which result in increasing costs per acre with the expansion of farm size. Others factors which, in practice, will limit

> farm size (such as limitations of management, land supplies or labor supplies), are omitted from this analysis because these items cannot be readily measured.
>
> Estimates of total production include losses in yields because of untimely operations which may arise during the following operations: (1) corn planting, cultivating and harvesting, (2) oats planting and harvesting, (3) soybean planting and (4) hay harvesting. Estimates of the rate of loss occurring when operations are performed during a suboptimal period were obtained from various agronomic and engineering sources. (pp. 447–48)

As a result of their analysis for the technology and production functions assumed, they concluded, "The envelope curve also indicates rapidly increasing per-unit costs at farm sizes above 800 crop acres" (p. 452). When the analysis was extended to consider year-to-year variability in weather and yields over a five-year span, they observed further, "that farm businesses might not survive if they expanded acreage to a point equating marginal cost and marginal revenue in an average year. In these two examples, when considering weather variations, the optimum farm size is 12 to 22 percent smaller than the acreage which gives minimum per-unit costs, and 27 to 37 percent smaller than the optimum farm size under the supposition of marginal cost and marginal revenue equated under acreage expansion" (p. 462).

One might ask why quote so much from a study made more than fifteen years ago. Unfortunately, few studies exist which provide additional examples where explicit assumptions are presented to explain potential diseconomies. More effort to specify the constraints which limit farm size for given sets of conditions might improve our ability to project change and expected responses when new technology becomes available.

Need to Anticipate Change

Continuing interest in economies and diseconomies of farm size stems from two quite different directions. First is the potential social and economic gain from anticipating and then recognizing major structural changes when they occur. Most in farm management did not recognize the revolution in size and structure that "suddenly happened" in the broiler industry. Many were also caught napping when the cage layer system came to dominate the egg-producing industry. Prompted by these lessons or observations from the poultry sector, some economists and journalists have concluded that similar revolutions were imminent or now in progress in the dairy and hog sectors of the economy. To recognize and evaluate both the potential economies and likely diseconomies or costs associated with new agricultural technologies remains one of the most challenging and difficult tasks for applied economists interested in agricultural production across several disciplines.

A second reason for looking at diseconomies as well as economies of size is a growing public and professional interest in establishing some kind of limits to farm size. Clearly this is not a new phenomenon. From the time of Commons, Taylor, and Warren there has been discussion about distributions of farms by size class and what this means for agriculture. But the prevailing concern of most agricultural economists has been to provide information and decision aids to assist individual farmers to recognize and then establish producing units large enough to compete successfully in a commercial environment. Heady and Jensen put it this way:

> Except during depression, persons with very little capital can make more income, have better living standards and accumulate capital more rapidly, if they work for wages rather than operate an undersized unit of their own. . . . Some people argue that state and federal governments should put an upper limit on farm size and try to increase the number of farms and people living on farms. . . . The answer seems more nearly one of having farms operated on a scale to insure a favorable living level for a reasonable number of farm families, rather than to have an excess of small farms surrounded by poverty conditions. (p. 449)

The majority of agricultural economists have been more concerned with increasing farm incomes and production efficiency in agriculture in the United States than in controlling the upper end of the size distribution of farms.

Two Major Groups of Farms

In the last twenty years, however, increasing numbers of voices within and outside agricultural economics have been asking: who will control agriculture; what is the amount of corporate involvement in production agriculture; what is the impact of government programs on large versus small farms (Carman, Coffman, Jensen, Penn and Boehm, Upchurch)? Increased interest has been expressed about America's largest farms and what their growth signals for the rest of agriculture (Breimyer, Nikolitch 1964, 1970, 1972). Using cash receipts as a measure of size, revised national statistics show that there were 162,000 farms in 1977 with $100,000 or more of cash sales (ESCS, p. 53). This group accounted for almost 53% of agricultural sales nationally, and 6% of all units classified as farms. If $20,000 of cash sales is set as a kind of lower limit for a commercial farm business, then there were about 830,000 farms in 1977 of this size or larger which produced 90% of agricultural output. That leaves about 1.9 million units, still described as farms, where the primary source of income for the family commonly comes from off-farm sources. Breimyer put it very well: "Paradoxically, the farming likely to show the most staying power may be the part-time or retirement farm that does not depend solely on farm income for its viability" (p. 22).

As this audience well recognizes, $100,000 of cash farm receipts can be generated easily by a one- or two-man business. Seventy dairy cows, or 10,000 layers, or 600 acres of corn and soybeans, or 1,200 acres of wheat and small grain will generate this much or more in sales annually. Compared with most industries, the degree of concentration in farming in terms of numbers of businesses is small.

But one still should ask, are these larger units technically less efficient than smaller ones? Have diseconomies of size already set in or are they likely to in the near future? Is our tax structure and incentive system such that ever–larger, but less efficient, farms are encouraged? If one looks back at the investment decisions of many commercial farmers at the time of rapid increases in the prices of wheat, corn, soybeans, and other crops between 1973 and 1976, the provisions for investment tax credits, generous depreciation allowances, and the cash basis for reporting federal and state income taxes seemed to encourage decisions which actually may have increased unit production costs, but simultaneously allowed retention of more capital in individual businesses. The U.S. tax structure probably has encouraged increased farm size, greater capital outlays, and the potential for higher unit cost production. Raup and Toussaint called our attention to this point ten years ago. Farmers' investment decisions in the mid-1970s have reinforced and verified their observations.

In Raup's words, "As farm size increases, management becomes a critical cost item. Management skills must be learned and producing a superior manager is expensive. To discuss the efficiency of farms of alternative sizes without allowing for the differential costs of producing a manager, plus the costs of management error, feedback and growth in skill, is to ignore one of the most important aspects of transition in size of farm" (p. 1276).

Incentives for Increased Size

What, then, is behind the drive to increase farm size if in fact most of the real gains in efficiency or reduced production costs have already been achieved by the time a farmer is generating $100,000 of cash sales annually (Bailey)? Why do farmers consciously accept a lower net return per unit of output and simultaneously take on larger risks, substantial new debt, and more management burden to get a bigger business? The answers are not the same for all farmers, but many common elements appear. First, more volume means greater net income unless unit costs rise very rapidly. Perhaps equally important, farm real estate has been a high return investment for the past forty years. Many farmers have made much more from appreciation in the value of their real estate than they have from crop and livestock production on their farms. It is natural to project past trends into the future even though current farm real estate values in most parts of the country far exceed anything one could expect by capitalizing net earning potential from farming back into the value of these assets.

Clearly, larger businesses mean labor-saving equipment and greater capacity to get things done on time. But status in the community, power that comes with the control of more resources, the excitement that comes with being in a recognized top group, the relatively easy access to capital for investment, plus an economic system that strongly encourages growth of businesses and new investment are all contributing factors to the drive to get larger. It is both a social and a business norm in our society that any successful business should seek to grow. Next year's sales target should be larger than this year's. That is part of what farmers see and learn from the environment around them.

If this picture of the incentives and drives for farm families to increase the size of their business is correct, then the divisions between commercial farm businesses and the very large number of part–time farms is likely to continue and grow more pronounced. The commercial sector, defined here as farms with $20,000 of sales and up, will continue to consolidate operations, and the total number of farms can be expected to decline slowly. The number of units with limited cash sales but still described as farms may well be quite stable or even increase unless national definitions for farms are changed.

If agricultural economists are to make informed judgments about the impact of different distributions of the commercial sector of farms by size groups on production efficiency and equity, we need to understand more fully current constraints to increased size at the margin and their associated costs. It is difficult to foresee a group of large corporations, each owned by a large number of stockholders and competing in international markets for capital, able to compete effectively in the near future with family units in most types of agricultural production. Farm families are willing to accept lower average rates of return on their capital and take greater risks than are managers and owners of corporate, nonfarm businesses. Put another way, annual rates of return on invested capital are higher and safer in most other industries than in production agriculture. Moreover, the wage rates and work schedules associated with labor and management in industrial corporations are substantially different from those on large, family-operated farm businesses.

Of course, these conditions may not always hold true with changing technology. As a consequence, we need to think about the combination of circumstances that might make an industrial type of organization for agriculture a reality and what the trade-offs would be if such were the case.

The Food and Agriculture Act of 1977 includes the following declaration:

> Congress hereby specifically reaffirms the historical policy of the United States to foster and encourage the family farm system of agriculture in this country. Congress firmly believes that the maintenance of the family farm system is essential to the social well-being of the Nation and the competitive production of adequate supplies of food and fiber. Congress further believes that any significant expansion of non-family owned, large scale corporate enterprises will be detrimental to the national welfare. (p. 7)

Most of us agree with this statement both emotionally and analytically. Farming is viewed as special and unique. Similar statements have not been made for other industries or sectors, or for any other component part of the food industry of which farming is but one element. What if changes in technology and management capacity actually suggested that least-cost production for some parts of agriculture is associated with large-scale producing units, perhaps so big that we cannot visualize them from current perspectives? For example, who would have been able to anticipate and describe the growth and development of a corporate giant like General Motors just 100 years ago? Is it not possible that the nation's egg supply might be produced by as few as five major corporations in a few more years? Would this necessarily be bad?

If the majority of the American people should conclude that it is in their collective interests to find ways to set limits on farm size, indirect methods are likely to be both more effective and more equitable over time than are a set of direct prohibitions or controls on land.

At the time of the Homestead Act, in many areas 160 acres provided enough land to allow a good livelihood with existing technology. Even then in locations where rainfall or soils were limiting, 160 acres were insufficient for an adequate livelihood. Legislating and then administering minimums and maximums for land and water is fraught with difficulty, as we are aptly reminded in the 1970s by the controversy over access to irrigation water from federally developed projects (Farrell et al.).

Some initiatives have already been taken by state legislatures to limit or prohibit corporate ownership of farm businesses. Ways are being sought to prevent foreign ownership of farm land, as well (Wunderlich). A somewhat different approach, which indirectly affects farm size and can be administered more easily, is a set of upper limits on the amount of government payments that any farmer may receive. Limits on subsidized credit programs also favor smaller commercial farms.

Tax policy at the federal, state, and local levels could be made effective in discouraging establishment of very large farms. But this requires that economists evaluate the impact of real estate, income, capital gains, estate, and inheritance taxes separately and in combination on investment decisions and accumulation of capital as well as production efficiency. Such applied research deserves much more attention in the years ahead, particularly in relation to farm size and the accumulation of family capital.

Concluding Observations

Farm size in the United States is highly variable, however one chooses to measure it. It is even more variable in the rest of the world. At one end of the spectrum are the state farms and collectives of the Soviet Union and Eastern Europe, the great estates of the Middle East and Latin America, and the far flung ranches of the North American mountains and prairies. At the other end are the tiny family farms of Korea, Japan, or Indonesia where having as much as one hectare of cropland turns out to be well above average. These widely divergent distributions of farms and farming systems developed under substantially different physical, social, political, and economic circumstances.

No single system or distribution of sizes is best or optimal in all situations. But at least economists should be able to say something about different structures over time on a comparative basis. In particular, our profession has a responsibility to assemble and provide evidence about what happens to resource use on very small and very large farms in different settings so that improved judgments can be made regarding trade–offs between production efficiency and equity.

Over the seventy-five years agricultural economists have been studying and observing farmers and their families, both in Western societies and others, some generalizations begin to emerge. It is not returns to capital, or returns to land, or returns to any single scarce resource, that motivates farm decisions. A farm family tries to get the most it can out of the bundle of resources it controls. And it is not net income by itself that matters to a family. Rather, it is some larger combination of things, including survival, net income over time, enlarging the bundle of resources that the family controls, and increased prestige within the local social system. In many cases around the world, family resources turn out to consist largely of family labor and entrepreneurship with precious little capital and land to go along with them.

It seems logical to emphasize family resources and employment as key policy variables in economic studies of farms and farming systems. As the Japanese and Dutch have demonstrated rather dramatically, quite different combinations of land, labor, and capital from those in America may be combined efficiently by able entrepreneurs. Even though land is fundamental to farming and a unique resource that is almost nonrenewable, perhaps too much emphasis has been given to land, and too little to family labor and management in our analyses. After all, it is people and not simply physical resources that take final priority.

Having just made a plea to give a little less attention to land in studying farm size, it is also important to recognize that control of "large" blocks of land remains an important issue. I will not try to define "large" because so much depends on the nature of soils, climate, and technology where the land is located. But once sizable areas are amassed in the control of one individual or one family, history shows that it is difficult to break up such concentrations short of war or revolution.

My own populist heritage influences this view. I grew up on a hill farm in Eastern New York. It was once part of Rensselaerwyck, a vestige of European feudalism brought to America when Kiliaen VanRensselaer of the Dutch West India Company established the patroon system in the Hudson Valley in 1629. In 1838, well after the Revolutionary War, Stephen VanRensselaer's[4] manor embraced essentially all of Albany and Rensselaer Counties and part of Columbia as well. The hill lands of Rensselaerwyck then covered more than 700,000 acres farmed by 60,000 tenant farmers (Christman). The antirent wars are a bit of long forgotten history. Hill farmers, dressed as Indians, tried to prevent the sheriff from collecting rents and dispossessing tenants from their farms. Their resistance was the catalyst for John Slingerland, the antirent congressman from Albany County, to introduce the first Federal Homestead Act in 1848. Much revised in detail, but not in principle, it became law fourteen years later, ensuring clear ownership rights to settlers who came to live on and farm our nation's public lands. Finally voters did what farmers could not accomplish by their meager armed resistance in Eastern New York. In 1852 the highest court in the State upheld the law confirming tenants as legal owners of their farms. It was not until the 1880s, however, that the majority of the original leases had passed finally into the hands of farmer–owners.

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[4] Interestingly enough, it was the well-known Federalist, Alexander Hamilton who perfected for his brother-in-law the lease that bound the new tenants in Rensselaerwyck permanently to the manor through its quarter sale clause.

This excursion into history should serve as a reminder that feudalism, once established, dies slowly. Those of us who are asked to advise on agricultural issues overseas should remember that justice has often moved slowly in our own country. Once title to land has been acquired, it is not easy to redistribute or subdivide it in the face of strong resistance by land owners.

Too many specific controls on the organization and structure of agriculture may not lead to desired results. Entrepreneurship needs encouragement. Change must be fostered if farming is to remain dynamic, efficient, and attractive as a business enterprise. A balance needs to be maintained that allows outsiders access to farm resources yet encourages those who are now farming to keep well-run businesses in operation. I am less concerned about the potential of giant corporations like General Mills, Pillsbury, or Corn Products taking over farming in the near future than I am about the current prices of cropland relative to their earning potential in farming.

The continuing challenge to agricultural economists is to improve our tools of analysis and our body of knowledge based on research and experience. If there are diseconomies to increased farm size, given current technology, let us seek to discover and measure them. If such diseconomies do not exist, then the numbers of commercial farms will decrease more rapidly in the next decades than they have in the last forty years. The issue of farm size, far from dead, is a recurring and lively subject for study.

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Some Forces Affecting the Changing Structure, Organization, and Control of American Agriculture

Harold O. Carter and Warren E. Johnston

The original broad charge given to us by President Hildreth for this address was to consider "the implications of the changing structure, organization, and control of American agriculture." Upon asking for a possible narrowing of the topic, Jim magnanimously agreed to change "the" to "some." Upon our suggestion to Jim of the names of several economists who knew something about this topic, he mumbled that he was looking for a couple of "appropriate types" to go "where angels fear to tread."

At the outset we should say something about the direction and scope of our comments. Our emphasis will be on structural change and control in agriculture, interpreted rather broadly. We single out land value escalation as an issue of major importance and deserving of special attention because of possible effects on the future structure and control of the farming subsystem. It is our contention that the driving forces affecting future changes are coming from outside agriculture, rather than from decisions made within.

Analyzing the past is a necessary first step in understanding present trends and future possibilities. Our procedure, therefore, is to provide first a short overview of structure research in agriculture and indicate how the policy/control aspects of agriculture have changed in concert with industrialization. Second, we review some of the major changes taking place in the food and agriculture system giving particular attention to the interface between production agriculture and nonfarm rural interests. We then examine the record on rising farm real estate values, considering selected external and internal forces and possible resultant effects on structure and control in agriculture. We conclude with general observations on future developments and problems ahead.

Emphasis of Previous Structural Analysis

The study of structural change and control in the food sector cannot be classified as a neglected area. In fact, many of our colleagues here today have made significant theoretical and empirical contributions on this topic. While no attempt is intended to review this work, one would be remiss not to mention the early efforts of the old North Central Regional Committee NCR-20, whose ideas spawned in 1974 the current North Central Research Project NC-117. Also, mention should be made of the contribution of the National Commission on Food Marketing and the National Advisory Commission on Food and Fiber. In addition, there are many fine marketing and farm management studies that have dealt with selective aspects of structural characteristics of agriculture.

The central theme of traditional research on structure has been to define the processes through which organizational changes come about with industrialization and how institutions adjust or are modified to implement reorganization. The industrial organization paradigm of structure-conduct-performance provides the main theoretical base for saying something about efficiency and behavior within rigorously delineated markets and for developing policy with antitrust orientation (Hildreth, Krause, Nelson). Yet, the recent concerns expressed about the "global reach" of multinationals (Barnet and Miller), conglomerates, and other actions that transcend

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Invited address.

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markets and countries leads one to believe that our traditional kit of tools comes up short. Furthermore, efficiency measures judged against a competitive model say little about external effects on equity and quality of life considerations with alternative structural/organizational/control configurations.

Technological determinism pervades much of the literature, yet concerns are voiced about the negative impacts of the self-adjusting market economy. Pleas for research about devising protective institutions to cushion the shock or modify the outcomes of markets have been often made but rarely answered. Traditionally, many of the institutions that have developed to modify market outcomes have sought to gain special exemptions for agriculture based upon arguments of uniqueness. But today's agriculture is vastly different and is highly integrated with other sectors of the economy or is becoming so.

Diffusion of Control

Control relates to control over decisions. Traditionally, control meant that farmers commanded decisions about input use and markets. The steady erosion or shifting of the power structure or control away from the farmer has fueled a continuous dialogue around the question: "Who will control U.S. agriculture?" Without succumbing completely to technological determinism, we should note that the evolution of U.S. agricultural policy tends to mirror the industrialization process of agriculture. Putting this same idea in terms familiar to political scientists, the structure of power behind farm policy has progressed, according to Garth Youngberg, from subsystem to macropolitics. Youngberg maintains that the "subsystem" exerted extraordinary influence upon agricultural policy making in former times because of a symbiotic relationship between local farm administrators, the commodity-based agencies of the U.S. Department of Agriculture (USDA), and the relevant agriculture subcommittees of the House and Senate. Bonnen refers to this policy formation process as the triangle of power and Charles Hardin labels it the bureaucratic influence. Over time, the gradual industrialization of agriculture has brought specialization along commodity lines. This increased interaction among specialized agribusiness firms as Bonnen stated "leads eventually to a fragmentation of economic interests and thus to conflict" (p. 20).

Further complicating this "polygon of power" were the newer interests from a broader spectrum of the body politic. For example, ecological concerns were voiced by environmentalists in the late 1960s. Inflationary food prices made activists out of consumers during the early part of this decade. The world food crisis of 1972–73, dollar devaluations, and the formation of the Organization of Petroleum Exporting Countries (OPEC) essentially added important international dimensions to food policy formation and, indirectly, to the control of decisions at all levels. An expanded list of economic, political, and other factors, therefore, characterizes the macropolitics of the 1970s.

Control aspects in all phases of the food and agriculture system have been diffused among a spate of governmental and private institutions. A diverse set of governmental and regulatory rules that bear upon the structure of the food and fiber system has been examined by Dahl. He concludes that most public policies directed to the solution of various income, equity, and growth problems have the perverse effect of increasing the concentration of firms at each level of farm supply, production, distribution, and merchandising. This conclusion seems extreme but plausible, and certainly worthy of further investigation. Another set of issues relating to proliferation of agencies and rules is their frequent lack of coordination, the increased uncertainty that they engender, and their cost, particularly to small operations, not to mention their cost-effectiveness from a societal point of view.

Major Trends and Structure Characteristics of U.S. Food and Agriculture

We now direct our attention to some key elements and structural changes in the agricultural-food sector. In describing those trends and characteristics, one is tempted to say merely that the industrialization process of agriculture is continuing. The agricultural labor force is still leaving the farm but at somewhat slower rates than previously, and purchased inputs are still increasing at a moderate pace. Markets for food and fiber have continued their long-term expansion trend, first from local to regional and national markets, and now to international markets. The volume of farm exports has increased significantly and now contributes importantly to offset deficit nonagricultural trade balances.

The evidence is still strong that the aggregate agricultural supply is highly inelastic and is moving to the right somewhat erratically—partly as a result of natural factors and partly by technological change, which some now argue is slowing. Aggregate demand is still highly inelastic, shifted mainly by population growth and now more strongly, but less predictably, by export demand. Resulting price behavior is extreme if either supply or demand shifts significantly. The extreme price fluctuations of the past few years lend credence to this simplified aggregate perception. Such a simple description, however, probably hides many interesting characteristics of a dynamic, complex, and changing agriculture.

In table 1 we capsulize the food and agriculture system in terms of key variables and indicators of change over most of this century. In summary, all subsectors of the food and agriculture sector have undergone structural changes generally in the direction of fewer and larger sized firms. Prices are increasingly being determined less by traditional, competitive, open market arrangements and more by contracts and arrangements between highly integrated concentrated subsectors of the food system. The extent of the transition is, of course, highly variable by commodity group and region (Reimund and Martin, Minden, Mueller, Grieg). For our discussion, however, we emphasize the production subsector and its rural interface.

Commercial farms are becoming fewer and larger, continuing past trends, but at a decreasing rate (Gardner and Pope). Numbers of farms in cash grain and other field crops showed substantial gains between 1964 and 1974 whereas numbers declined in cotton, tobacco, dairy, and general farms—tending to be consistent with shifts in export markets. Farm output in terms of sales is concentrated towards larger units, the top 40% of the farms accounting for about 80% to 90% of the nation's output, and the bottom 40% for only 3% to 5%. These percentages have changed little over the last decade. Numbers of tenant farms continue to decline and full-owner farms increased between 1964 and 1974. In terms of numbers of farms, individual family farms still predominate (90% of total); whereas less than 2% were classified as a corporation in 1974.

The mix of purchased and nonpurchased inputs on farms has been altered substantially with rather continual increases in purchased inputs over time displacing those internal to farms. For specific inputs, farm labor use has decreased since 1930, but the rate of decrease has diminished. The shift towards mechanization was particularly strong during the pre-World War II period, while the use of fertilizers and other chemicals showed the most rapid growth during the 1950s and 1960s. All of these shifts in input use contributed to increased productivity.

Because of the dominant position of the United States in world agriculture and trade, productivity changes as well as production capacity assessments are followed with considerable interest and concern. Total factor productivity in the farm production subsector, as measured by the USDA index (1977a), has been substantial—1.9% annually since 1950. Some evidence of slowing down in productivity is causing concern, despite the fact that the rate of increase has been 2.0% annually during this decade. Schuh expressed this concern of stagnating productivity growth in his invited address to the association two years ago. He cited the declining rate of the USDA productivity index in the 1960s and evidence presented by the National Academy of Sciences showing diminishing returns of fertilizer to land and eggs per hen as portending similar biological limits for other classes of crops and livestock.

On the other hand, D. Gale Johnson (1977), who had participated in the productivity chapter in the NAS study, expressed doubt about the reliability of published measures of productivity in agriculture. One can arrive at different conclusions regarding productivity growth in the 1960s compared to the 1950s, depending on which productivity index is used. Denison shows farm productivity declining only very slightly in the 1960–69 period compared to the 1950s. The USDA (1977a) productivity index, on the other hand, shows a lower growth rate than Denison in the 1950s and a relatively large reduction for the 1960–69 period. Kendrick shows considerably higher rates of farm productivity growth for the 1950–60 period than either Denison or the USDA, but the relative drop off in the 1960s compared to the 1950s is similar to that estimated by the USDA.[1] Our point in making this comparison is not to criticize any of the methods used but to suggest the need for further empirical and conceptual research in this important area.

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[1] Computed annual rates of change in farm productivity are as follows: Denison, 1950–59, 3.2%; 1960–69, 3.0%. USDA (1977a), 1950–59, 2.4%; 1960–69, 1.5%. Kendrick, 1950–59, 4.3%; 1960–69, 2.7%.

The concept of production capacity, however, involves more than just productivity. Changes in output over time are explained by (*a*) movements along the production function and (*b*) shifts in the production function. It is the shifts in the production function that we identify with technological change and label "productivity." The production capacity measure relates both to changes in technology and increases in input use. Maximum production capacity corresponds to the maximum point on the new technology production function—that is, a level of production physically attainable at some future specified time (a point assuming zero input prices or an infinite product price). Most capacity studies, however, would identify production capacity with a solution consistent with a "feasible" input/output price ratio. Quite obviously, what is considered feasible may well differ among researchers, and this accounts partially for different assessments by researchers of the future U.S. or global agricultural production capacity. Another source of discrepancy arises from differences in perceptions about future changes in technology and the rate that changes are adopted. We raise this issue because of its obvious implication for expectations that contribute to the formation of land values, a topic which we discuss in a later section.

While we do not intend to discuss many aspects of rural areas, it is important to note the blurring of the lines between agricultural and nonagricultural interests in those areas. For example, note the trends toward part-time farming and the growth rates of nonmetropolitan areas. In 1930, less than one in six farms were part-time. Now two out of three farm families receive more than half of their income from nonfarm sources. Increased nonfarm incomes have reduced the migration to urban areas allowing a "middle ground" between staying in agriculture and exiting completely. Partly as a result, there has been a slow but steady convergence of income of farmers with that of workers in the nonfarm sector. Income of farm operators from nonfarm sources continues to increase over time and now makes up three-fifths of total income in the farm sector.

There are only one-fourth the number of people on farms today as there were in 1910. The proportion of the U.S. total population on farms fell from 35% to less than 4% from 1910 to 1976. The number of people classified by the census as "rural," however, has been rather constant and now constitutes one-fourth of our total U.S. population. Nonmetropolitan areas in the 1970s have been experiencing faster growth rates than metropolitan areas. If this trend continues, it will profoundly influence the size and composition of rural populations (Beale) and represents a reversal of one of the nation's best established long-term population trends.

These trends highlight the fact that nonfarmers are of growing importance in the rural areas of the nation. Their competition with farmers for land has exerted an upward pressure on farm real estate prices.

Forces Affecting Land Values and Farm Structure

American agriculture has a long tradition of common ownership and operation of farm units. Recent high land prices bring into serious question the continued feasibility of land ownership by what we generally consider to be family farmers. From 1950 through 1972, the value per acre of U.S. farm real estate increased at a (nominal) rate of 5.6% annually, compared to a 2.8% rate for general prices. The increase in land values occurred despite rather stable annual levels of realized net farm incomes. In contrast to this earlier record of steady, but modest, increases in farm land values, per acre values jumped sharply over the period 1972–1977, at a 16.5% annual rate compared to a general price increase of 7.1% annually. A tripling of land values has been reported for several Corn Belt states as farmers and others responded to higher grain and soybean prices in 1973–74 and have continued to bid up farm land prices.

The sources of recent land value increases are less clear than those existing prior to 1972. Traditionally, pressures for farm enlargement and the capitalization of net farm incomes along with urban and recreational demands for farm lands explained a major share of the changes in land values in a market where generally less than 3% of the land changes hands annually. Some of the factors now attracting capital into agriculture include: (*a*) farmers attempting to expand to achieve economies of scale and/or capitalize anticipated returns from expanded domestic and world markets, (*b*) nonfarm investors (and some pure speculators) seeking to realize a hedge against

Table 1. Some Characteristics of the U.S. Agricultural and Food System, Selected Years 1910–1976, and Annual Rates of Change

Characteristic	Units	1910	1930	1950	1960	1970	1976	Annual Rate of Change 1910–50	1950–76	1950–60	1960–70	1970–76
								(%/year)				
U.S. and the world												
U.S. gross national product	(billion 1972 dollars)	n/a[a]	285	534	737	1,075	1,275	3.2[e]	3.4	3.3	3.8	2.9
Gross national product implicit price deflator	1972 = 100	n/a	32	54	69	91	134	2.6[e]	3.6	2.5	2.8	6.7
Ratio of exports to gross national product	percent	n/a	4.3	3.6	3.9	4.3	6.7	—[b]	—	—	—	—
Ratio of imports to gross national product	percent	n/a	3.4	3.2	2.9	4.1	7.3	—	—	—	—	—
Trade balance:												
agricultural	(million dollars)	+82	−404	−191	+509	+1,272	+12,246	—	—	—	—	—
nonagricultural	(million dollars)	—	+1,173	+3,269	+3,105	+958	−15,477	—	—	—	—	—
Farm shares/U.S.												
Share farming/national income	percent	n/a	n/a	7.2	3.9	2.8	2.6	—	—	—	—	—
Share farm labor force/U.S. labor force	percent	30.9	21.2	11.6	7.9	4.0	3.2	—	—	—	—	—
Farm production												
Index of farm output	1967 = 100	43	52	75	90	105	117	1.4	1.7	1.8	1.6	1.8
Index of farm input	1967 = 100	86	101	105	101	99	101	0.5	−0.2	−0.4	−0.2	0.3
Index of total productivity	1967 = 100	50	51	71	89	105	116	0.8	1.9	2.3	1.7	1.7
Input use: nonpurchased	1967 = 100	158	177	152	120	96	90	−0.1	−2.0	−2.3	−2.2	−1.1
purchased	1967 = 100	38	50	71	86	103	113	1.6	1.8	1.9	1.8	1.6
Farm labor	1967 = 100	321	329	222	145	91	78	−0.9	−3.9	−4.2	−4.6	−2.5
Farm real estate	1967 = 100	98	101	105	100	97	94	0.2	−0.4	−0.5	−0.3	−0.5
Mechanized power and machinery	1967 = 100	20	38	85	96	101	113	3.7	1.1	1.2	0.5	1.9
Agricultural chemicals	1967 = 100	5	9	29	50	117	141	4.5	6.3	5.6	8.9	3.2
Prices received by farmers	1967 = 100	41	47	103	95	110	186	2.3	2.2	−0.8	1.5	9.2
Prices paid by farmers	1967 = 100	28	43	77	88	113	192	2.6	3.6	1.3	2.5	9.2
Number of farms	(1,000)	6,366	6,295	5,388	3,962	2,954	2,752	−0.4	−2.6	−3.0	−2.9	−1.2
Land in farms	(million acres)	881	990	1,161	1,177	1,103	1,081	0.7	−0.3	0.1	−0.6	−0.3
Average size of farms	(acres)	139	157	216	297	373	393	1.1	2.3	3.2	2.3	0.9
Rural sector												
Total U.S. population	million	92	123	152	181	205	215	1.2	1.4	1.8	1.3	0.8
Farm population	million	32	30	23	16	10	8	−0.8	−3.8	−3.8	−4.6	−2.6
Ratio farm/total	percent	35	25	15	9	5	4	—	—	—	—	—
Rural population	million	49	54	54	54	54	n/a	0.2	−0.1[c]	−0.1	—[d]	n/a
Ratio rural/total	percent	53	44	36	30	26	—	—	—	—	—	—
Rural-farm population	million	n/a	30	23	14	8	n/a	−1.4[e]	−5.0[c]	−5.2	−4.8	n/a
Ratio rural-farm/rural	percent	—	56	42	25	15	—	—	—	—	—	—
Income from farm sources/total income (farm population)	percent	n/a	n/a	69	61	47	42	—	—	—	—	—
Per capita disposable personal income: farm population/nonfarm population	percent	n/a	n/a	65	56	75	82	—	—	—	—	—
Domestic demand												
Real (1972 prices) personal disposable income	(billion dollars)	—	211	362	487	742	890	2.7[e]	3.5	3.0	4.3	3.1
Per capita	(dollars)	—	1,709	2,386	2,697	3,619	4,137	1.7[e]	2.1	1.2	3.0	2.2
Consumer expenditures for food/personal disposable income	percent	n/a	24	22	20	16	17	—	—	—	—	—

	Units	1947	1954	1958	1963	1966	1970	1972
Inputs								
Selected concentration ratios[f]								
Fertilizers	percent	36	n/a	34	34	34	30	n/a
Farm machinery	percent	n/a	n/a	n/a	43	45	40	n/a

Processing and merchandizing								
Selected concentration ratios[f]								
Meatpacking plants	percent	41	n/a	34	31	27	23	20
Canned fruits and vegetables	percent	n/a	n/a	n/a	24	24	21	20
Frozen fruits and vegetables	percent	n/a	n/a	n/a	24	24	26	29
Cereal preparations	percent	79	n/a	83	86	87	90	90
Bread, cake, and related products	percent	16	n/a	22	23	25	29	29
Average weighted concentrated ratios[g]	percent	37.7	38.0	37.2	37.9	38.6	39.3	n/a
Total retail stores	(thousand)	n/a	n/a	359.5	319.4	294.2	267.4	n/a
Market share of large grocery chains[h]	percent	n/a	29.4	n/a	n/a	36.1[i]	n/a	38.9
Food processing establishments	number	n/a	n/a	23,210	20,228	16,718[i]	n/a	13,180

[a] Not available.

[b] Not appropriate.

[c] 1950–70.

[d] Less than 0.5%.

[e] 1930–50.

[f] Value of industry shipments accounted for by four largest companies.

[g] Average weighted four firm concentration in thirty-one food and related industries (Mueller).

[h] More than 101 stores.

[i] 1967.

inflation or tax shelter, and (*c*) part-time and hobby farmers and other persons migrating to rural areas.

Farmers have continued to buy land to expand farming operations to achieve economies of scale. Demands for land more recently have been based additionally on growth in domestic and foreign markets and fed by heightened expectations and concerns of world scarcity, diminished productivity, and inflation. Demand and consumption of food and agricultural products have been altered over time in most countries due to several factors including income and population changes as well as shifts in policy. The commodity composition and direction of trade flows over the past twenty-five years provide evidence of pronounced world trends which are mirrored in past structural shifts in U.S. agriculture. The most significant change in the commodity composition of world agricultural trade since the 1950s has been the relative increase in food and especially feed exports (feedgrains, feeding stuff, and oilseeds) at the expense of agricultural raw material (cotton, tobacco) exports. The relative importance of food and feed exports (as a percentage of world agricultural trade) increased from 45% in 1950 to almost 69% in 1976. During the same period, agricultural raw materials declined from 29% of the total world agricultural exports to 11% (Mackie). The trends in U.S. agricultural exports are similar to world trends except feed exports showed an even greater relative increase.

Apparently, the 1972–73 shock has created a more lasting impression on expectations than might be warranted. A recent world food report by the late Tony Rojko and co-workers summarized results from their own study and five others published between 1973 and 1976. Two conclusions were common to all studies, particularly with reference to the grain sector: (*a*) sufficient productive capacity exists at the global level to meet food needs of the world's population well beyond 1985 and (*b*) regional food production/consumption imbalances will persist and for some areas possibly worsen by 1985. In these studies, projected regional deficits of cereals in the developing countries vary from a low of 22.5 million tons to a high of 118.1 million tons (Carter, p. 304). Much of this extreme variation can be explained by differences in technological changes assumed in the respective reports. While the studies point to more than adequate physical capacity of the world's resources to produce grain well beyond 1985, the political and institutional problems are viewed as tighter constraints. Nonetheless, it would appear that many land purchasers are "betting" on high deficits, and some, on famine. Scott, for example, shows that income from two additional acres of land in Illinois would be needed to pay for an acre of $4,000 land if the price of corn remains at $2.25 per bushel. Purchases at such high prices can only be rationalized by expectations of a return to scenarios of high 1973–74 commodity prices, or by the investment-like use of land as a hedge against anticipated high inflation.

Windfall capital gains from equity in farm land, realized as the result of the initial land price surge from high commodity prices, further sustained demands even after prices and net incomes slacked off in 1975. Historically, the annual capital gain in real estate value has been less than annual net farm income (e.g., 20% of net income in 1960 and growing to 60% by 1970). Since 1971, however, capital gains from land were substantially larger than net income (almost 1.75 times larger than net income in 1975). Increased use of credit has also sustained the demand for farm land by farmers. The proportion of transfers on which debt was incurred rose from 58% in 1950 to 88% in 1977 and the ratio of debt to purchase price of credit-financed transfers rose from 57% in 1950 to 77% in 1977 (USDA 1977b). Melichar suspects that the increased debt financing in the farming sector is concentrated among a relatively small proportion of farmers, primarily those who have significantly expanded their operations in recent years. He also suggests that the repayment of past borrowings will be impossible if cash flows fail to rise above recent levels for heavily indebted farm units. Not only would those farms with heavy debts be affected, but small rural banks which have been involved in farm lending and have low liquidity could be seriously affected. Thus, the structures of farm land and farm credit have been substantially altered by developments in the 1970s.

How does farm land compare to other commodities or even to the stock market as an investment alternative for the nonfarmer? The gross national product (GNP) price deflator rose by 7.1% annually since 1972, about half the rate for farm real estate. Like land, spot market prices for primary commodities showed a sharp rise from 1972 to 1974, but leveled off at lower prices in more recent years; and the behavior of common stock prices has been "flat" during much of this decade. While land values continued to escalate beyond 1974, spot market prices fell by 7% from their 1974 level and stock prices rose only slightly. Healy and Short cite the favorable comparisons of land markets with common stocks and the general price level to show an inflation-hedging motive for land purchase. This contrasts with the 1950s and 1960s when annual rates of return were found to be greater for common stocks compared to land appreciation rates. Both Kost and Johnson found, however, higher variability in returns for common stocks than for land during this earlier period.

Again we raise the question of whether investors' expectations have exceeded some bounds of rationality. Do expectations continue to push land prices upward in ever self-fulfilling promises of continual land price appreciation? Stephen Roulac reminds us of the "South Seas Bubble" episode in which "land prices were bid up to unwarranted levels as a result of rampant speculation" (p. 53), and suggests the reading of Mackay's 1841 book, *Extraordinary Popular Delusions and the Madness of Crowds*.

Demand for land by hobby farmers, foreign buyers, and those seeking tax-shelters in farm land has been characterized as being price inelastic by Raup. A study of a farm real estate market in California (Johnston) indicated that nonresidents (some of whom were out-of-county farmers) paid an average of 36% more per acre for farm land of equal quality than residents were willing to pay. The demographic shift leading to larger population growth rates in nonmetropolitan areas (Beale) generates yet another set of nonresident demands for land. Higher per acre prices paid for farm land by nonresidents, regardless of nationality, brings mixed blessings to individuals and groups. Absentee landowners have long provided rental lands to farming operations, but debate about the residency requirement in conjunction with farm units under the 160-acre limitation in the West and about foreign ownership of U.S. farmland are recent expressions of popular concern. Both are debates with more emotional overtones than clear economic rationales, having common ground in the concern about the control of large-scale commercial farms under absentee ownership.

What implications does the land boom have for the structure and control of American agriculture? After all, farm investment and land-price booms have occurred previously in the United States. Four such periods preceding World War II were each followed by about two decades of severe farm mortgage debt distress, but the last complete boom (1941–52) was not followed by debt repayment problems (Melichar). Agricultural adjustment problems in the 1950s and 1960s were eased somewhat by the fact that, according to Melichar, farm land prices were consistent with the level at which the federal government (or public) was willing to support the prices of major crops. We are now involved in the sixth land boom but the macropolitics would suggest less willingness on the part of the government to underwrite target prices at the "appropriate" levels in spite of militant actions of the American Agricultural Movement (AAM) this past spring.

Consider the family farm, with a moderately flexible definition thereof, in the boom environment. Both Barkley and Raup have stressed the resiliency and capacity of family farms to absorb risk, suggesting the public goods-like nature of these basic units. The comparative advantage in bidding land away from neighbors, however, appears to be with medium to large farmers (Harris and Nehring), giving further impetus to potential increases in the incidence of larger farming units at the expense of smaller units. Although it does not follow necessarily that larger units may deviate substantially from family farm norms, continued pressures that move agriculture towards entities with heavy reliance on capital markets may be particularly threatening to family farm units.

Two other concerns of structural change are worthy of discussion: intergenerational transfer and entry of new farmers. Problems of intergenerational transfer (Harris) compounded in the past by increasing land values have been eased in one aspect by the recent estate tax revision which permits assessment on the basis of capitalized net rents rather than market values. While there are suggestions of differential tax provisions for agriculture (e.g., capital gains) we have concern that in the general economic setting in which farming now finds itself, special tax treatment will have such perverse effects as attracting additional capital investment, further driving up land prices, and further stimulating the separation of ownership of farm land from farm operation.

Entry into agriculture has been made more difficult by higher resource costs (including land) and the growing size of operation, which, even if land costs did not rise, would necessitate increased capital investment requirements. With 1976 asset values, capital requirements for farms with $40,000–$60,000 gross farm sales are estimated to range from $285,000 for fruit and nut farms, of which $196,000 is farm land value, upwards to $573,000 for livestock ranches, with $459,000 for land (Hottel and Berry). These are already formidable capital requirements. With land appreciating at 16.5% per year as it has since 1972, these land values will double within five years. The effect on capital requirements for entry are evident.

In summary, spiraling land prices have been the result of escalated commodity price expectations and persistent inflation in the general economy, among other factors. The toll may be high in terms of the future structure of agriculture's productive sector, as indicated by difficulties in entry, intergenerational transfer, and unity of ownership and operation. To the extent that lack of clarity or firmness in governmental policy or action either spawns or sustains these conditions, the structure of farming as we know it is jeopardized. U.S. monetary policy, for example, as it influences the inflation rate has had greater repercussion on farm structure than any policies generated in the USDA. Counteractions of higher support prices, credit write-offs, subsidization, preferential tax treatment, and the like, can no longer be directed just to farmers. Actions of this nature will be capitalized into higher land prices. Consequences of stock corporations in land, or even a landed aristocracy, are not beyond imagination unless the forces in the maelstrom are dissipated.

Concluding Comments

We conclude by "treading" lightly over a few main points if for no other reason than to confirm President Hildreth's selection process. Our attention was focused on selective elements and forces in the economic system that we considered important determinants of what we loosely call structure, with particular attention directed toward changing land markets.

A general observation is that after the introduction of the tractor, the most important shock affecting the structure of American agriculture in this century has come from abroad in the form of increased market interdependency. Two years ago at our annual meeting Schuh and Warley both presented excellent papers that emphasized the importance of viewing the agricultural sector in the context of an open or interdependent world economy. Two points are particularly germane to our discussion: (*a*) the world of a system dominated by only two superpowers has been replaced by one including a number of participants (EEC, Japan, OPEC, multinationals), and (*b*) a growing perception that economic interdependence has its costs as well as its benefits.

Many of our trading partners put greater reliance than the United States upon direct government intervention either separately or in regional trading blocs. Accordingly, policies that focus upon nondiscriminatory reduction of trade barriers obviously are viewed differently depending on the context of each bloc's, or country's political and economic objectives. The point has been made many times that barriers to trade, of whatever kind, and highly protectionistic domestic agricultural policies are a source of instability in international commodity markets (Johnson 1975). Faced with this reality, the United States has reaped the benefits of expanded markets for both agriculture and the general economy in terms of reduced trade deficits. However, the costs of these benefits have been in terms of greater price and income instability which is an onerous burden to small undercapitalized farmers. Since much of the trade gains have been associated with feed crops and cereals, the regional impacts of the instability are disproportionate, as well. Some reduction in instability can be accomplished with a buffer stock policy which, of course, is not without its costs.

In addition to trading blocs and trade barriers, multinationals—some with incomes that exceed the incomes of national governments—have become a force of unknown influence and concern in the international economic system.[2] There is little knowledge about their effects on key economic aggregates either in host or parent countries or how they interact in "mixed" markets.[3] As economists we simply lack appropriate conceptual models to deal with the newer structural dimenstions of international markets and marketeers.

A second observation that we made, perhaps colored by our regional bias, is that the transformation of American agriculture, or if you prefer the food and fiber system, is now approaching a post-industrial stage. Agriculture, particularly production agriculture, has lost its uniqueness. The special treatment that agriculture has demanded and received in practically every segment of its operation is slipping away. Probably the last vestiges of special treatment involve agricultural labor and legal dispensations for operating cooperatives and marketing orders and agreements. Even these vestigal remains are disappearing, for the recently enacted California Agricultural Labor Relations Act will probably be the prototype for other states, and cooperatives and marketing orders are under intense scrutiny.

It would be premature, however, to consider the agricultural establishment as impotent or agrarianism as completely dead in the current political environment or in future deliberations. We need only consider the Food and Agriculture Act of 1977 and the lobbying efforts of the new American Agricultural Movement (AAM) early this year. Target prices were enriched by the Administration beyond the 1977 Act provisions partly as a result of vocal, and sometimes militant lobbying activities. A strong and concerted effort will continue to be made to incorporate full funding of land costs in computing the cost of production for price supports. New "actors," new coalitions, and new researchable problems are emerging to deal with the broader food and agriculture issues in a postindustrial society.

Mention also should be made of the "small is beautiful" proponents led by the late E. F. Schumacher. Is this a serious counterforce to the persistent trends toward industrialization of agriculture? We think not, at least not in the extreme forms espoused by those preaching a return to a "man and nature" society. The dialogue, nevertheless, is a manifestation of concern about the impacts of a self-adjusting market. The changing interface between commercial agriculture and quasi-agricultural interests in rural areas and the rising capital requirements in farming suggest an emerging compromise in the form of a dual rural economy similar to that proposed by Wunderlich:

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[2] The U.S. is the largest home country of multinationals, accounting for over 50% of all direct foreign investment, well above the 14.5% of second place Britain (Bergsten et al.). Next is West Germany at 4.4% and Japan at 2.7%. It has been estimated that the largest five multinational exporters account for 90% of U.S. trade in wheat (Freivalds). There is little reason to believe that the concentration is any less for exporters of U.S. coarse grains and soybeans.

[3] An interesting attempt to look at international markets within a structural and behavior framework is contained in a paper by McCalla. While considering national policy objectives and their impact on world trade, he concludes that much remains to be done before we have a satisfactory model explaining just the international pricing mechanism, not to mention some of the other dynamics of the global market.

(*a*) large commercial farm units, and (*b*) smaller farms, the latter based mainly on subsistence, part-time, retirement, and hobby interests. If such a structure is to emerge and coexist in harmony, much research remains to be done on the amelioration of conflicts and external pressures that are already disrupting the rural/urban fringe.

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Institutional Economics and Political Economy Revisited: Implications for Agricultural Economics

Gary Storey

Two issues stand out in the Presidential, Fellows, and Invited Addresses of the American Agricultural Economics Association (AAEA) over the past decade. These are (*a*) the appropriateness of our theory, and (*b*) the adequacy of our approaches in dealing with the problems relevant to the agricultural economics profession. The two issues are interrelated because our theory will evolve by adequately approaching the relevant problems that face us as agricultural economists. These issues relate directly to questions of the importance of institutional or behavioral dimensions in our theory (Shaffer, Schultz, Ruttan 1971) and the responsibility of professional agricultural economists in the area of public policy (Castle 1977, Farrell, Nielson, Bishop, Breimyer, Hathaway).

The first objective of this address is to examine, revisit, if you will, the importance of the ideas contained in institutional economics for the evolvement of our theory for problem solutions. In addition, the paper discusses issues relating to questions about our responsibilities as professionals within society, the ideas of which are contained in the notions of political economy.[1] Implications of these two subject areas are then drawn for the institutions and major organizations which the profession encompasses.

The subject matter of the address has several roots. It stems from my concern as president with the role of the Canadian Agricultural Economics Society (CAES) to the profession in Canada.[2] It stems from my personal concerns over the performance of the agricultural economics profession in Canada in research of the more important problems facing society and in communication with the public. In addition, the address is an attempt to stimulate discussion and to provide a point of view at a time when the Society is at its crossroads.

The basic argument contained in this paper is that the future direction, role, and responsibility of Canadian agricultural economists essentially follows the logical consequences of accepting a broader set of problem perspectives for the profession. These problem perspectives are well described in past Presidential, Fellows, and Invited Addresses of the AAEA. They are generally as applicable to Canadian conditions as they are to the United States.

The logical consequences are a set of prescriptions which include reappraisal of our current received theory which has been based on the methodology of the physical sciences, and thus positivism, and the return to the broader principles of activity and responsibility as implied by political economy. These prescriptions suggest that our conventional theory as taught and as applied has tended to exclude the elements of institutional change (Shaffer; Ruttan 1971, 1974; Schultz) and the accompanying notion that the process of tech-

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Presidential Address, Canadian Agricultural Economics Society.

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The author is indebted to George E. Lee and W. Hartley Furtan for their insights and guidance, to W. H. Furtan for assistance with the manuscript, and to the remainder of my colleagues in Agricultural Economics and L. F. Kristjanson, for their constructive criticism and comments. The author alone is responsible for the contents.

[1] For purposes of clarity and hopefully not debate, I will define an "institution" as a societal behavioral rule, custom, or tradition, as distinct from "organization" which will be used to refer to a body of persons organized for some specific purpose such as a university, government agency, etc. I will explain "political economy" as a discipline which encompasses a body of economic and political science principles as well as moral philosophy.

[2] The concern for the CAES mirrors the general concerns for the AAEA as expressed by Hildreth (1977) and Breimyer. In the Canadian context concern focuses on possible fragmentation of the Society by subdiscipline, by region, and by differences of view over continued CAES affiliation with the Agricultural Institute of Canada (AIC). The latter problem mainly relates to the differences of view held by Canadian agricultural economists over the decision by the AIC to engage in public policy debate, to take positions, and to speak out on various agricultural policy issues in the name of professional agrologists (i.e., agriculturalists) in Canada.

nological innovation interacts through processes of social learning and changes in man's behavior to induce changes in institutions.[3] This is meant to imply that the acceptance of a new, and broader, set of problem perspectives should as a result induce a re-evaluation of our conventional theory. In addition, it should induce changes in the approach we take to our professional activities of teaching, research, extension, and to our responsibilities in the areas of public service and public policy.

Prescriptions essentially have called for a broadening of the profession in research to include other social and natural science disciplines. This follows from the realization that the scope of our profession is likely insufficiently broad to research the problems of an increasingly interdependent and complex world society.

It is further argued that as a profession we have generally failed to discover the ingredient or process to facilitate the necessary changes to address the more complex issues and problems of society as contained in the problem perspectives. Taken as a new set of goals or objectives, it suggests that current procedures are inadequate by which the profession allocates its scarce resources to maximize its professional outputs in terms of teaching, research, extension, and advisory services at the university, governmental, agribusiness, farm, and consumer levels. More simply said, our means, in terms of approach and theory, have not been consistent with our ends, taken as problem perspectives.

The paper does not claim to have discovered this ingredient or process. It attempts, however, to bring forward the argument that the answer to our questions of professional redirection and reorganization of the Society is in part contained in the notions and implications of political economy and institutional economics. To elaborate, the prescription of what to do will follow from the profession developing the mechanisms to induce institutional changes that can be applied to the profession itself.

Let me now turn to the subject matter. I will first briefly discuss problem perspectives of the profession and the associated questions of appropriateness of theory and the need for the adoption of concepts of institutional innovation and political economy within the profession. I will then discuss the procedural implications for professional activities.

Problem Perspectives of the Profession

The problem perspectives of agricultural economics in Canada and the United States relate to the breadth of the profession as reflected by the fields of specialization of its members.[4] If these fields of interest can be taken as the legitimate subject matter, it reflects a wide potential problem area for agricultural economics application.

A review of past Presidential, Fellows, and Invited Addresses of the AAEA provides an appraisal of current agricultural economics research. These addresses suggest a tendency to work almost exclusively on short-run, current problems and to avoid research of the longer-run problems that will face agriculture and society in the future. There has been a tendency to deal with the narrowly drawn issues rather than the longer-run complex and controversial issues (Farrell). Concurrently, the profession has also tended to avoid problems that require multidisciplinary research with either social, natural, or agricultural science disciplines. Traditionally, the broader agricultural profession, encompassing the various disciplines of soil, plant, animal, agricultural economics, and other sciences, had accepted its responsibilities to engage in problem-solving that led to research deepening. The phenomena studied were largely bounded by the discipline, and this has been generally applicable to both university and government research.

We need to examine agricultural problems in the context of an entire production and marketing system, and to look at the structure of agriculture and its linkages to the rest of the economy, both urban and rural (Nielson, Tefertiller). I believe that we are just starting to realize the full implications of the interdependencies that exist, the complexity of the evolving structure of our agricultural system, and the implications it holds for our research approaches. It is a realization that the technology which we create through our research not only affects resource quality and use but also the institutional dimensions of agricultural society. We also are starting to realize that we need to know more about how institutions affect agricultural structure and performance.

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[3] This notion can be expanded to suggest that technological and institutional changes are induced and are interdependent where institutional change has lagged behind technological change because of greater efficiency of technology research plus the greater resource allocations made to technological research as distinct from social research. I am indebted to W. H. Furtan for this clarification.

[4] The 1976 AAEA *Handbook-Directory* lists members by field of interest. No similar handbook exists to document the breadth of the agricultural economics profession in Canada but that breadth is assumed to be somewhat the same.

For example, in the context of Western Canadian agriculture, the institutional notion of equity held by early settlers has had a strong influence on such areas as marketing and policy. A specific example—the grain delivery quota has attempted to serve the dual role of controlling grain movement from the farm through the marketing channel for purposes of efficiency and equalizing delivery opportunities among farmers. The quota is based on the amount of cultivated land per farm; it does not take into account land or farm productivity. In years where production has tended to exceed system capacity, the quota has served to limit sales, resulting in farm surpluses. This has had important implications for land use, land values, resource allocation, and income distribution.

This is but one example of how an institution can affect agriculture. Our research has tended to avoid explicit treatment of institutions. The structure of agriculture will depend upon how these institutional beliefs change and how these changes, in turn, will influence technological changes in production and marketing. It also will depend upon how technological changes induce or influence institutional change. Our theoretical suppositions currently cannot handle these questions very well.

In turning to the problem perspectives of the environment, Kelso provides an even more difficult challenge by requiring us to "incorporate in our analytical structure the conception of the closed spaceship earth, improvement in the well-being state rather than maximization of the through-put of the system, together with all relevant preference sets and institutional elements as endogenous variables rather than as exogenous parameters" (p. 823).

What does all this have to do with institutional economics and political economy? For one thing, it raises serious questions about the appropriateness of our conventional theory to deal with this broad and complex set of problems. It also raises questions about the current approach taken by our profession and the acceptance of our responsibilities to public policy issues.

Implications of Problem Perspectives: The Need for an Appropriate Theory?

Let me clarify one point first. I do not intend to imply that the agricultural economics discipline or profession necessarily subscribes to one body of theory; I imply only that the mainstream of agricultural economics currently holds to theory that embodies principles of general equilibrium. It tends to embrace positive rather than normative economics. Neither do I suggest that agricultural economics, and thus economics, has avoided theoretical controversies or disagreements. In fact, the opposite is true; the development of economic thought has been steeped in divisiveness where there have existed different schools of thought. I also should point out that although I tend to dwell on questions of appropriate theory, questions about the appropriate use of theory could also be discussed. However, that will have to be left to another paper.

What is an appropriate theory? I suggest that theory in the context of agricultural economics as an applied discipline must be judged on the basis of its usefulness in solving relevant problems. This statement suggests a pragmatic view of theory and thus does not necessarily agree with conventional wisdom. It appears, however, that the questions raised about the ability of our conventional theory to answer the important questions of the day have tended to increase.

In some respects, we should not be surprised that our theory may not be appropriate to solve current problems. Economic theorists have tended to be relatively pragmatic in devising a set of prescriptions that will solve the economic problems of the day. These prescriptions result from theoretical models which have been constructed, based on the astute observations of the structural relationships and behavioral propensities of the current society. The models so constructed, although useful for their day, could not stand the test of time. They could not because the behavioral conditions and organizational structure of society did not remain static. This has been true for Marxian economic theory, neoclassical economics in the 1930s, and neo-Keynesian economics in the 1970s, and it also applies in part to our instability to solve a number of the agricultural problems today.

One of the key issues surrounding the development of economic theory has been its boundaries. The proclivity to simplify theory and to avoid the unknown of human behavior resulted in a conventional theory that has avoided the evolutionary notions of Darwin and has reduced man to a self-serving calculator of pleasure and pain. The scope of conventional economics is thus reduced to an examination of how given means are applied to satisfy given ends. Georgescu-Roegen states, "The question is why a science interested in economic means, ends, and distribution should dogmatically refuse to study also the process by which new economic means, new economic ends, and new economic relations are created" (p. 320). It is this latter point of new economic relations that appears to be most lacking in our conventional theory.

It is this point that resulted in the rise of institutionalism. In a recent book on institutional economics, Seckler explains, "Not only did institutionalism arise out of an essentially similar milieu in the first two decades of this century, but its platform of protest against what may be called the mainstream economics of its day was very similar to contemporary complaints" (p. 1). As its leading exponent, Thorstein Veblen's first article on methodology asked: "Why is Economics Not an Evolutionary Science?" Seckler explains, "Veblen contended that economics was incapable of becoming a true science because of its methodological presuppositions. It assumes man to be a rationalistic, choosing individual attempting to maximize his well-being. Given this assumption, Veblen said, economics is reduced to a mere exercise in empathy. All it can do is attempt to guess what such a man would do by deductive logic designed to simulate his (alleged) mental processes. With these premises, Veblen said, economics is 'teleological,' 'taxonomic,' and 'tautological'—in a word, all that genuine evolutionary science is not" (p. 7).

The institutionalists, particularly Veblen, attempted to make economics an evolutionary science by examining the cumulative process of change. They argued that economists should study the introduction and changes in institutions over time. To understand this process, Veblen said, it was necessary to understand the characteristics of humanity. Although he flirted with both behaviorism and humanism, he never succeeded in developing a defensible theory based on either one.

That the institutionalists failed to replace neoclassical theory is not the question. Neither is it important that Thorstein Veblen, John R. Commons, and Wesley C. Mitchell failed to develop a single school of thought. The important observation is that they were a reform movement that turned to the social theories of psychology, sociology, and anthropology for their inspiration and direction in attempting to develop an evolutionary theory with institutions treated in an endogenous manner.

The Need for a Theory of Institutional Change

Following from the tradition of institutional economics, our body of theory would attempt to incorporate the concept of institutional change and innovation. Institutional change has, traditionally, like technical change, been treated as exogenous to the economic system. Conventional theory has not been very successful in explaining or predicting either technological or institutional change. Theory has not been able to determine whether institutional change through institutional innovations can be induced. A new or modified theory would attempt to measure how innovations occur, both technological and institutional.

Theory should be able to explain the relationship between institutional and technological change. Coming back to the problem of grain delivery quotas, one might ask, what is the relationship between equity held by farmers and structural and technological changes in Western Canadian agriculture. Is there a line of causality? Have the behavioral notions of equity induced innovations in grain marketing including the grain delivery quota system itself? Has this in turn affected farm structure and eventually technology? Or has technological change through its effect on farm size and income affected behavioral notions held by farmers which, in turn, affect farmers' preferences for marketing methods? These are not questions of idle curiosity because the implications for resource use, distribution of income, market system performance, and agricultural policy are significant.

The economic theory appropriate to our problem perspectives therefore requires a complete understanding of systems, technological and human. The theory then would embrace evolution, which requires an understanding of man's changing behavior and culture over time and, thus, institutions.

The development of the broader conceptualization of theory raises a series of questions for which I do not purport to have answers. It raises the question of appropriate epistemology and approach to experimentation. The fact that we make endogenous a large subset of variables that we traditionally have treated as exogenous would undoubtedly create numerous problems in testing, which raises questions of appropriate experimental methods.

I will put forward the proposition that classical experimental science, which is based on the assumption that the exogenous variables of the system under study are highly deterministic, is likely inappropriate to experimentation of a system that is highly evolutionary in nature (Dunn). If we attempt to endogenize human behavior by incorporating institutional change, it implies that we are not just concerned with the effect on some endogenous system variable but are concerned with the effect on system behavior and, thus, performance. It assumes, further, that the experiment itself is not neutral (Heisenberg principle), and thus the ability to retest in an environment that remains largely unchanged as is feasible in physical and biological science is likely not applicable for the social sciences. Even the biological and physical sciences appear now to be questioning their scientific methodology because of the lack of neutrality of their research given the specters of genetic engineering and nuclear energy. It implies that our research, in attempting to solve social problems, results in behavioral changes that must be evaluated against whether or not the results improve the system's performance. This further implies that the researcher has some set of societal goals against which research performance can be measured. This has the most significant implications for an acceptable methodology and professional conduct and relates to questions discussed under political economy.

A much broader conceptualization of our economic theory in terms of institutional and, thus, behavioral change requires an understanding of the process of social learning. It requires that we know how man thinks individually and collectively. It requires an understanding of how man makes decisions within a changing technological and institutional environment. This raises the obvious questions about approaches to research for solving social problems. For me, at least, it provides the rationale for multidisciplinary dialogue, theoretical investigations, and research. The need for an understanding of the process of social learning in the context of economics suggests work in the areas of sociology, anthropology, psychology, political science, and, likely, philosophy. I do not suggest that this will be easy or necessarily bear immediately useful results.

The Need for a Return to Political Economy

Given the problem perspectives of the profession, it can be argued that agricultural economists in the main need to re-adopt the broader disciplinary concept of political economy. As the forerunner of economics and political science, the earlier practitioners, Adam Smith, Ricardo, and John Stuart Mill, as political economists, were activists in the public policy issues of their day. Many occupied seats in moral philosophy.

As Lord Robbins explains, the inaugural lectures of the early political economists usually contained arguments for the practical value of their subject. They pleaded for greater recognition. Over time, as economics developed into a separate discipline, the economics profession was not only accepted, but economists were called upon to solve a wide set of problems, many of which were beyond their professional capability. This realization, coupled with a dual sense of science and ethics, caused economists (agricultural economists included) to embrace a more positivistic approach, to avoid normative statements, and to develop a detachment from policy prescriptions. Have we gone too far? What is the correct approach to policy matters?

In "The Nature and Significance of Economic Science," Lord Robbins argued rationally against the economist taking positions on matters of public choice over different ends. He recommended against all but the economist laying out the alternatives and implications of different economic choices. Twenty some years later, he appeared to have changed his view. In "The Economist in the Twentieth Century," Lord Robbins asks, "Does recognition of the limitations of economics as a body of knowledge imply that, in this agitated world, we economists are to remain aloof, detached and indifferent, content to point out to bewildered men the inconsistencies of their various actions, but never taking part in the grand debate of what these actions should be" (p. 15). He answers, "in my opinion, it would be a great pity if economists in the present age were to depart from the habits of their predecessors and to refrain from participation in the discussions of what, to use the old term, may conveniently be described as questions of political economy. I think it would be regrettable if they refrained from discussions of the ultimate ends of society" (pp. 15, 16).

It is these "ultimate ends of society" that create concerns for our profession in deciding upon our responsibilities for our research findings and our responsibilities to society. I have argued earlier that our profession cannot avoid questions of goals (ends) and values, because our research findings are seldom neutral; that is, unless they are hidden and cloistered in dust somewhere.

Through this process, man, the researcher, influences the evolutionary course of history. The broader theoretical approach involving institutional change and choices as to where other system components such as resources are endogenized, implies that societal ends, or goals, must be an integral part of theory. Through research and prediction, man influences the attainment of his ends which, in turn, modifies the ends or goals. Because this further effects the choice of means, it has a feedback effect on research which is now evaluated against a new set of goals or ends.

It follows that technological and environmental change affects human behavior and institutional rules of behavior, customs, and habits. These changes, in turn, modify societal goals and values through a process of social learning. Therefore, any research carried out that can influence technological change and/or institutional change must have impacts on changing goals and values. Our research is not neutral with respect to the ultimate ends of society.

For example, how does the marketing economist evaluate research on the effects of alternative grain delivery quota systems except against what effects it has on total system performance. Because alternative quota systems will likely affect income distribution, problems of evaluation are difficult. What can welfare theory tell us?

What are the implications for the activities of the profession?

Implications for Teaching, Research, Extension, and Administration

The most fundamental implication of the problem perspectives as delineated, subsequent questions of the appropriateness of theory, and appropriateness of our research methodology is the need for a multidisciplinary or interdisciplinary approach. I will not enter the argument whether the approach should be multi- or interdisciplinary (Schultz, Castle 1972) but it at least requires cooperation of the science disciplines. This multidisciplinary recommendation has been echoed time and again in past Presidential, Fellows, and Invited Addresses before these meetings (Castle 1972, Farrell, Bishop, Tefertiller, Nielson).

If the agricultural economics discipline embraces a new theoretical approach encompassing institutional and environmental dimensions, then many of the conventional theories' suppositions will have to be modified. New theory texts for introductory principles courses will take on a more encompassing view of man and environment. Agricultural economics, along with principles of ecology, could provide a framework for integrating other course material in biological, physical, social, and agricultural science courses.

This approach would appear to offer an excellent framework for an introductory course in agricultural economics. It would reflect one of the strengths of our discipline, particularly within colleges of agriculture, which is the ability to serve an integrating function. This approach should appeal to students because it would give them a framework to see the interdependencies and linkages in the agriculture and food system.

I think it will also be important to depict the agricultural economist to students as one who is not detached but who is involved and concerned with societal problems. Teaching devices that involve students in policy questions and theory applications need to be strengthened.

The current failures of our research agenda have been cited primarily as short-run and small problem-oriented. The failures are alleged to result from our institutional notions of democracy and independence. Our universities have jealously guarded the freedom of the individual researcher to choose his own research agenda and to carry it out in a manner of independence. The promotion and reward systems of the university and the society, respectively, focus on the individual achievement in terms of publications (Castle, Farrell).

How do we make the transition to a new set of institutional and organizational arrangements, rules, and customs, to promote the new research agenda? The theory that technological innovation and change induces institutional change might suggest that the growing technology of our research hardware through computer capacity to program or simulate and thus solve large complex models, along with growing data banks and communication networks will induce the appropriate institutional changes to make use of this technology for those purposes. This enabled the type of experimentation carried out by the Club of Rome which was a notable effort in attempting to predict and illustrate potential problems that face future society.

Is it possible artificially to induce appropriate institutional innovations and change beyond what technology will create? In discussing Ruttan's paper (1973) on "Technical and Institutional Change and the Future of Agriculture," Pereira felt that Ruttan placed too much emphasis on the impact of technological change in the inducement of institutional change. Pereira felt that the causal relationships between technological and institutional change can work in both directions. He also felt, and I think this is important for us "that the major institutional changes in agriculture are dictated by socio-political factors and not merely economic ones" (p. 55).

To me, this might suggest that agricultural economists can play a direct role in changing the institutional rules that govern and influence our teaching, research, and extension programs. What better way than through the communication of ideas and arguments. This could be done within existing organizations, with funding agencies, and to the general public. It would be consistent with the tradition of political economy and the implications of involvement rather than detachment from the public policy arena. Agricultural economists, economists, and other social scientists might lead the way.

As previously stated, our research agenda has been criticized for being too short-run, too prone to work on problems that have little social payoff. It has been suggested that we have been too removed from our public, farmers, agribusiness, consumers, and that we need contact to develop correctly our research priorities (Nielson). I can agree only in part. If we follow this prescription for all our research, we are most likely to find ourselves working on the short-run, privately oriented problems rather than the longer-run social problems. Why? Because of our twin institutional economic devils, the private versus the social discount rate. It implies that we cannot totally accept market signals of what research to undertake. Bishop was aware of this problem and pointed out that the interests of economists extend far beyond market phenomena. To follow our instincts and undertake the longer-run research problems is somewhat elitist, unless we take the lengthy process of educating the public to the needs for solving longer-run societal problems.

In terms of implications for extension, I agree with Hathaway that in many respects our extension work has already tended to be multidisciplinary. Since our extension efforts tend to be the result of teaching and research, a new emphasis on taking concepts of agricultural systems to producers and agribusiness should result. The technology of research results that is systems-oriented itself, should induce institutional and organizational changes in extension methods. The technology of communication and computer systems that will be made available to farmers and rural developments groups in the future will create changes in adult education and other extension approaches.

In terms of administration, several warnings have been sounded. Nielson described very clearly the need for agricultural economists to be "accountable." He attributes leveling off of support for education and research to a loss of public confidence in universities and government. Nielson advises: "As we look ahead and consider limited funds and competing demands for them, we must turn to our professional commitment to optimum resource allocation . . ." (p. 867). He further warns that we will have to improve our procedures for deciding on priorities and allocating scarce funds for uses in our programs as well as other uses. This has implications for our independence and democracy in establishing research priorities.

It suggests that research fund allocations made through a competitive market approach, where independent researchers overreact to a new set of problem perspectives, might result in an overflow of research resources, talents, etc., toward the multidisciplinary, long-run, complex problem areas. If this were to occur, it would create an even greater disequilibrium and misallocation of resources than we have at present. This is an agreement with Castle (1977) that "in the short run, we should exercise self-discipline and not pretend that agricultural economics is capable of dealing with all social problems" (p. 830). As stated at the beginning of the paper, we may have to give up some of our current independence in choosing our own research problem areas in favor of increased planning. If necessary, I would hope it is in the tradition of social democracy implying participation by individual professionals in planning the research agenda rather than dictated from somewhere up the administrative hierarchy. This warning was sounded by Farrell in 1976.

As everyone I am sure realizes, the biggest part of our research, teaching, and extension efforts will still rest with the more traditional problems of society. This realization also applies to the questions of appropriate theory. Any new theory incorporating institutional dimensions and an evolutionary nature will not immediately result in an abandonment of the core of conventional theory. Work on particularly micro (firm) level problems in such areas as farm management, marketing, production, and finance will still rely largely on conventional theory. Modifications will undoubtedly occur, but it will be an evolutionary process.

Implications for Agricultural Associations (Societies) and Public Policy

To what extent have or will American and Canadian agricultural economists embrace the propositions put forward by Kelso a year ago, or the prescriptions for an increase in multidisciplinary research, or the suppositions of this paper? I do not know. But we must not be afraid to find out because our future course and performance of the profession could depend upon it.

The Society can play a very important role in creating a climate, if not taking direct action, for the appropriate institutional changes to bring the means of professional activities and financial support into line with our professional responsibilities and goals. This can come about through workshops and seminars spearheaded by the Society. But this may not be enough.

The Society might have to take the profession's case to the public for the support needed for research and other professional services. This would be in the best traditions of the early political economists. This, however, would be carried out only with the assurance that there was a current misallocation of resources and our profession was in deficit.

The adoption of a new more holistic theory and multidisciplinary approach in theory development and research has implications for professional organizational structure. The Society should discourage subdisciplinary fragmentation, because it would be inconsistent with the realization of the growing need for interdependency in teaching, research, and extension, not only within agricultural economics, but with other agricultural science disciplines. The Society must, however, recognize the professional needs of each subdisciplinary group and find the appropriate structure and organization to facilitate these needs. A fragmented profession could mitigate against the type of discourse and activities necesssary to obtain the integration of professional research and extension efforts across disciplines. To go further, the prescriptions for multidisciplinary activities has implications for mechanisms and organizations necessary to facilitate discussion and to plan coordinated programs.

In Canada, the Agricultural Institute of Canada (AIC), an organization encompassing all agricultural science societies and professional institutes of agrology,[5] is in the position to perform part of this integrating role. As for the AIC, it has done this only perfunctorally to date. Although somewhat biased, I suggest that agricultural economists (maybe ecologists as well) are probably best equipped to take leadership here. I suspect if we did not have such a body as the AIC, we would create one to provide a mechanism to facilitate cross-disciplinary discussion within agriculture. This need also has implications for relationships with other social science disciplines.

This raises questions about the most useful affiliations for individual agricultural economists and the Society. I suggest it should lie largely within the agricultural sciences and thus with the AIC. As argued, agricultural economists need to broaden their research agenda and theoretical investigations with other social science disciplines. But this likely will involve a small percentage of the total agricultural economics profession in Canada. This group, which is composed mostly of university professors and government researchers and is the group most likely in need of contact with other social science disciplines, can do this individually through other societal affiliations. The Allied Science and Learned Societies meetings are possibilities.

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[5] Agricultural scientists from Quebec are only represented through the Societies.

The highest percentage of agricultural economists are engaged in professional applications within agricultural colleges, departments of agriculture in government, and agribusiness. The main cross-disciplinary contact needed for dealing with problems is with other agricultural sciences. In addition, most of the research carried out at universities and within government is likely to be still highly agriculturally oriented.

What should be the responsibilities of professional bodies such as the AAEA, CAES, or AIC on public policy issues? The AAEA is still debating membership in CAST. In Canada, the AIC, after a period of introspection and restructuring, has decided it must 'speak out' on issues of agricultural policy. It has developed and presented papers on such issues as food, energy, and land policies. It takes the case of agriculture directly to government and the public. In other words, the AIC purports to speak for all agricultural professionals in Canada on matters of agricultural policy. I feel, however, that this is not possible, and such actions taken by the AIC may in future endanger the unity of the agricultural profession in Canada. On matters that affect the profession, itself, in terms of research fundings, etc., the professional body can move more safely and should speak out.

But is it necessary to act as a lobby group on matters of public policy? Or is it sufficient to facilitate the development of position papers on policy as is the CAST approach? I opt for the latter.

A task force approach facilitated by the professional member organizations would appear to avoid the problem of implicating all professional members on positions taken yet provide a mechanism by which the profession can take an active role in public policy debate. Again, this is in the traditions of political economy. This approach could also help to induce changes in public opinion, changes in existing institutions, and thus increase support, if such support were found to be economically necessary.

This new set of responsibilities for our professional bodies raises questions about the structure of our professional organizations. Is the voluntary organization capable of such endeavors? If so, it implies that the organizational structure will have to be capable of soliciting contributions from a wide spectrum of members. This further implies, in terms of performance, that members will have to give the organization high priority in their full agenda job responsibilities. How to create this dedication and this sense of responsibility in a voluntary organization is a major challenge.

Concluding Comments

The Presidential, Fellows, and Invited Addresses of the AAEA have established a tradition of excellence and reflect the stewardship felt for the Association and the profession. It is in this tradition that President Hildreth a year ago appealed to AAEA members to establish excellence in developing agricultural economics knowledge and to raise all members' appreciation of excellence in teaching, research, extension, and decision making.

My message in support of those of Farrell, Hildreth, Hathaway, and others is that we must discover the appropriate set of procedures to foster (induce) institutional changes and prescriptions within the profession (as means) to reach the problem perspectives (as ends) that we accept as the responsibility of the profession. The method is to be found largely through an involvement in public policy issues and the approach implied by political economy. It is also to be found through increased communications withn the profession. This has particular significance in Canada because of our regional and organizational isolation in university, government, and agribusiness. It implies a greater responsibility and need of the professional organization to devise the appropriate methods for communication. It further implies the need to develop a journal and possibly other publications which are appropriate for the unique characteristics of the Canadian agricultural economics profession.

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The Changing Organization, Structure, and Control of Canadian Agriculture

Terrence S. Veeman and Michele M. Veeman

Public interest in the agricultural sector in Canada has greatly increased since 1973. Canadian consumers continue to be worried by increases in food prices and their causes. The farm production sector faces continued income instability in the short run, relatively low incomes for many (though not all) producers, and apparent increases in the degree of inequality in the distribution of agricultural income and wealth. Canadian taxpayers are in no mood, it would seem, to increase the relatively modest (except for the dairy sector) levels of direct government support to agriculture. During recent months, the dialogue on a potential food strategy for Canada has continued. To our mind, this debate, while fruitful to some degree, has not always identified the major issues facing Canadian agriculture nor clearly outlined the possible solutions and hard choices that Canadian society might undertake.

In this paper, we present our perception of how the structure and organization of Canadian agriculture is evolving and outline some major areas for policy attention and societal regulation. In the course of our discussion, we examine the primary production sector and the marketing economy.

The Primary Production Sector

The basic features of structural change in Canadian agriculture, as in most rich industrial nations, are reasonably familiar. Since World War II, Canadian agriculture has been characterized by increasing total output, rising total factor productivity (though increasing much more slowly recently), a high rate of growth of labor productivity (exceeding that in nonagriculture), substantial increases in real capital values per farm, declining numbers of farmers and farms, and increasing farm size (table 1). Although output per unit of labor has increased significantly, the capital-labor ratio has increased even faster; the substitution of capital for labor has been caused by increases in the price of human time relative to the price of producer goods and the associated labor-saving nature of induced technical change. Concommitantly, the capital-output ratio in Canadian agriculture has tended to increase. The type of capital used, especially in the grains economy of the prairie region, has tended to be labor-augmenting in nature rather than land-augmenting—that is, machinery rather than fertilizer (Furtan and Lee).

Despite the absolute advances in total agricultural output, agriculture in Canada directly contributes a relatively smaller proportion of national output than in earlier years. In the mid-1970s, agriculture's share of Canadian gross domestic product had declined to only 3% to 4%. Furthermore, the agricultural sector directly employs fewer workers, both absolutely and relatively, than in the past. The number of farmers and farm workers has declined from 939,000 in 1951 (some 18.4% of the total employed labor force) to 474,000 in 1976 (some 5%).

This tendency toward structural change with respect to the role of agriculture in the Canadian economy is the result of several longer run economic forces which were outlined by Schultz over three decades ago (Brandow, pp. 214–16). Some of the events of the 1970s—notably lagging productivity growth, the energy crisis (with the concern expressed by some that capital for labor substitution would be seriously constrained, if not reversed, by lack of fossil fuels), and the resurgence of foreign export demand for grains—have temporarily overridden, but at

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Invited address.

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Table 1. Changes in Canadian Agriculture, 1951–76

Item	1951	1961	1966	1971	1976
Number of agricultural holdings	623,091	480,903	430,522	366,128	338,578
Number of farms with sales of $1,200 or more[a]	387,072	354,107	338,559	299,868	300,118
Average farm size (occupied acres per holding)	279	359	404	463	499
Real capital value per holding (1971 $)	23,030	36,519	53,062	65,736	113,174
Real value of land and buildings per holding (1971 $)	13,441	23,908	36,647	46,257	86,397
Real capital value per man (1971 $)	1,529	2,579	4,199	4,719	8,084
Real net farm income per holding (1971 $)	4,696	2,568	5,331	4,411	8,161
Agriculture's share of total GDP (%)	11.8	4.2	5.3	3.4	3.3
Agriculture's share of labor force (%)	18.4	11.2	7.6	6.3	5.0
Share of consumer expenditures on food (%)	22.9	18.6	17.0	15.4	15.2
Agricultural exports ($ million)	1,020	1,193	1,862	1,993	1,960
Share of grains and oilseeds in agr. exports (%)	72.6	81.0	74.9	73.3	75.9
Agriculture's share of total exports (%)	26.1	20.7	18.5	11.5	10.6
Share of agricultural production exported (%)	37.3	40.8	43.2	43.7	39.4
Share of total cash receipts from crops (%)	41.6	38.0	41.2	38.2	46.0

Sources: Compiled from Statistics Canada 1978, Agriculture Canada 1977c, and Statistics Canada, various issues.

[a] This size category corresponds to the definition of a census farm introduced in the 1976 Census.

least in the medium term have not eliminated, the fundamental and pervasive forces which Schultz saw at work in North American agriculture. The absolute amount of labor employed in Canadian agriculture may have temporarily stabilized at slightly less than half a million during the past five years; similarly, the number of (census) farms with sales of $1,200 or more may have increased very slightly between the 1971 and 1976 census. Nevertheless, we anticipate that the number of farmers and farms in Canada will further decline, albeit at a slower rate, in the years ahead. In fact, the apparent stability in the number of census farms between 1971 and 1976 at 300,000 is a statistical illusion generated by price effects since large increases in prices, especially for grains, have brought more agricultural holdings over the $1,200 level (for an outline of this bias on census farm numbers in the United States, see Gardner and Pope). Agriculture Canada's estimates for the year 2000 of 250,000 agricultural holdings in Canada (composed of 85,000 full-time commercial farmers, 40,000 full-time small farmers with inadequate incomes, and 125,000 part-time farmers primarily dependent on nonfarm income) or less than 200,000 census farms do not seem out of line (Agriculture Canada 1977a, vol. 3, p. 64).

Associated with the decrease in the number of farms has been the steady increase (whether measured in terms of average sales level, capital invested, or land area) in average farm size. We anticipate that further increases in the size of the farm unit will occur although, again, the rate of change probably will be slower. Horizontal integration is a partial solution to some of the structural problems of agriculture and yet a problem in itself. To the extent that smaller, marginal farm units can increase their land base and become viable units, horizontal integration is in the public interest. However, if increasing farm size merely indicates that larger, commercial farm units are becoming even larger, horizontal integration may be more questionable. We enlarge on this theme as our discussion proceeds.

Canadian farms have become increasingly specialized, particularly with livestock production. The major source of production for most poultry, eggs, potatoes, and hogs has switched from mixed farms to relatively specialized farms. Between 1971 and 1976, the number of census farms reporting milk cows decreased 30%; similarly, the number reporting hogs declined 45%, a result of the high actual and opportunity costs of feed barley and the less pressing financial need for farm diversification. As in the United States (Breimyer), the trend toward separation of livestock and poultry enterprises from feed crop production has continued. One factor that may affect specialization in cash grain crops, at least in western Canada, is the increasing recognition that current cropping and summer-fallowing patterns may be leading to serious loss of soil fertility and encouraging salinization.

The fear that the family farm is disappearing and being replaced by the corporate farm is frequently expressed. However, the overwhelming majority of farms in Canada are family-related business concerns. In 1976, 91.5% of the census farms were single or individual proprietorships with only 3.8% in partnerships and 4.4% in legally constituted companies (corporations and a very small number of cooperatives). Of the corporations, 85.9% were family corporations. Corporate farms controlled 9% of the occupied farm land area and nearly 8% of the improved land area in 1976 in Canada. In 1971, over 8% of the total value of sales came from corporate farms. In 1976, we can only speculate—given the retrogressive step of Statistics Canada in eliminating this and other income distribution information in the 1976 Census—that some 10% to 15% of gross sales came from corporate farms (and the vast bulk of this from family incorporations). Roughly one-quarter of the corporate farms in 1976 had sales of $100,000 or more and about the same proportion had gross sales levels under $10,000, an indication perhaps that many farms in this latter category were hobby farms.

It is true that the number of corporate farms nearly doubled between 1971 and 1976 and that the recent extension to corporate farms of capital-gains rollover provisions—that is, the nontaxing of capital gains on intergenerational transfers—may spur additional incorporations among farm families. It is important that we monitor trends with respect to this type of business organization and collect data not only on numbers but also on its economic significance and performance. Moreover, it may be necessary to make our tax and institutional structures more even-handed in the treatment of incorporated as opposed to nonincorporated commercial farms. We suspect that the main motivation for incorporation is tax breaks unavailable to the single proprietor, rather than reasons of limited liability or generation of external finance.

Vertical integration by agribusiness in the farm production sector is not a major, nor apparently growing, phenomenon in Canadian agriculture. There are certain notable exceptions; vertical integration is extensive in vegetable production in various provinces (and particularly potato production in New Brunswick), hog finishing in Quebec, and broiler production in Quebec and elsewhere. However, the Agriculture Canada assessment (1977a, vol. 1, part A, p. 84) is that the aggregate level of control exercised by agribusiness firms over farm production, particularly by outright farm ownership, has been declining in recent years.

Canadian agriculture is, and is apt to remain, a family farm-oriented industry. But it is hardly a small family farm-oriented sector. The central issues for Canadian agriculture relate to how many family-related farms there should be, how production should be distributed among them, what specific programs we should have for poverty level farms, and how policy—in the realms of price, marketing, credit, and tax matters—should be geared to the increasingly dominant commercial farms, virtually all of which are family concerns.

Among the most striking changes in Canadian agriculture in this decade has been the dramatic increase in capital value per farm, led by a near doubling between 1971 and 1976 in the real value of land and buildings per farm. At the present time, the average nominal capital value of a census farm in Canada exceeds $200,000 with at least three-quarters of this total accounted for by the value of land and buildings. Farm land values have increased substantially in all parts of Canada, but the increases have been greatest in the prairie region of western Canada, which contains well over one-half the census farms and over four-fifths of the occupied farm area in Canada.

The causes of escalation in farm land values are complex, but many of the forces that have been suggested as operative in the United States (Raup) exist in Canada as well. Chief among these are the recent high prices and incomes for several agricultural products, especially grains, and the nature of the institutional structure within which farmers have operated in an inflationary period. The impact of foreign investors, the demand of urbanites for recreational land, and the loss of prime farm land to urban sprawl are often ascribed as reasons but are relatively minor influences in the agricultural economy as a whole. In fact, most of the demand for agricultural land has come from within the farm community itself—usually neighboring farmers and, we suspect, typically larger operators who already had an established base, who were relatively debt free, and who suddenly were faced with larger incomes. A major cause, then, of the rapid increase in farm land values, at least in the prairie region, has been the capitalization of the unprecedented high prices and net incomes of cash grain farmers in recent years into the value of a relatively fixed asset. We would conjecture that the pressure to buy land and expand the size of the farm has been related primarily to "income and wealth" effects, rather than to efforts to exploit significant economies of scale. Evidence on economies of scale is scanty for larger-scale operations, but we suspect they are minor once a grain farm has reached two or more sections in size. Not only did larger, established farmers have the increased income and wealth base to purchase land, but investment in real property was likely seen as the best hedge against inflation in the 1970s and as a sound investment when capital gains were also included in the imputed income stream. The economics of buying a costly additional quarter or half-section of land might look poor in marginal accounting terms (comparing the present value of the expected realized net income stream from the additional unit of land with its cost), but the established operator was able to absorb this high-cost addition within his existing farm, financing it out of his internal savings and the anticipated net revenues from the entire operation.

The farm family could also reap the benefits of a major portion, if not all, of the capital gains because the Canadian tax structure taxes capital gains at a lower rate than earned income and capital gains taxation can be avoided on father-to-son transfers. In this regard, we agree with the position that an incorporated family farm should face the same tax situation in intergenerational farm transfers as a nonincorporated family farm. However, the question here is whether larger family farms, incorporated or not, should be able to avoid capital gains taxation in integenerational transfers or, for that matter, other forms of taxation. The possible advantages of keeping farm units intact in such transfers must be weighed against the social disadvantages of ignoring inequality in the distribution of income and wealth in the agricultural sector and in Canadian society.

Although income concentration is less than in U.S. agriculture, there is considerable inequality in the distribution of income and wealth in Canadian agriculture. Unfortunately, our empirical data base on inequality and on changes in inequality over time is relatively weak and fragmented. There is some census information (not collected in 1976) which shows that the distribution of gross agricultural sales became increasingly concentrated over the 1950s and 1960s. The analysis of farm tax-filer information for nonincorporated farms in 1971, 1973, and 1974 (Agriculture Canada 1977b) also provides valuable insights. The tax-filer statistics underline the significance of off-farm income to the welfare of farm families; for instance, off-farm income constituted 72% and 56% of the total income for farm tax filers in 1971 and 1974, relatively weak and buoyant years for on-farm income, respectively.

It is clear that there continues to be a substantial poverty-level segment in Canadian agriculture. Even in 1974, some 36% of Canada's 395,000 farm tax-filers had total net incomes of less than $5,000. Of this poverty-level group, slightly over half were small farmers who derived more than 50% of their income from farming. The relative incidence of poverty was highest in eastern Canada, but the absolute numbers of poverty-level farm tax filers were highest in Ontario, Alberta, and Saskatchewan in 1974. The available Gini coefficients measuring the degree of inequality in the distribution of net income from all sources for farm tax filers in the 1970s indicate no conclusive trend in income concentration. It is interesting to note that in 1974 income concentration for farm tax filers with primary dependence on farming (some 60% of all farm tax filers) was greater than for the group as a whole, an indication that income from on-farm sources was more highly concentrated.

In any event, we strongly suspect that the degree of inequality in the distribution of income and wealth in Canadian agriculture has not improved and, in all likelihood, has worsened over time. The dichotomization of Canadian agriculture into a commercial farm sector and a poverty-level sector has long been recognized (Federal Task Force on Agriculture). The events of the 1970s appear to have led to an increasing domination of Canadian agriculture by the larger commercial farms.

Agricultural policy in Canada has been weak in dealing with poverty problems, income distribution issues, and wealth concentration in the agricultural sector. In broad terms, Canadian agricultural policy has attempted to deal with the historic low income problem in agriculture by adopting price and marketing programs which deal with farmers on a commodity group basis and which do not clearly differentiate the needs of the poor from the not-so-poor within agriculture. This is not a new problem in North American agriculture

(Brandow), but it is certainly an enduring and continuing issue in the United States (USDA) and Canada (Veeman and Veeman).

Admittedly, the level of government intervention and, particularly, direct price support in Canada has been, and remains, relatively modest compared to most rich industrial nations, including the United States (except perhaps during the "Butz era"). Our most highly subsidized agricultural sector is the dairy sector with 1977–78 dairy program costs estimated at 325 million dollars. We hope that there will be a re-examination of dairy policy in Canada within the next few years, but political and regional realities may militate against major policy changes.

There is some recognition by economists that the low income problem in agriculture may need to be solved more selectively through such "people programs" as targeted and graduated assistance to low income producers, guaranteed annual income plans, or negative income tax schemes, rather than across-the-board commodity programs that influence the incomes of all producers (typically in proportion to the output or productive base of the farm unit). However, the political feasibility of such new initiatives appears limited. Canadian society has been slow to deal with issues relating to poverty and income distribution. Moreover, particularly in times of fiscal restraint, governments are likely to continue to prefer agricultural programs that limit direct treasury costs and involve the transfer of indirect subsidies from consumers to producers, as we currently see in some marketing programs based on supply management and "cost of production" pricing formulas.

During the recent export boom for crops, the general postwar declines in the importance of the crops sector relative to the livestock economy, and the production sector relative to the marketing sector, were temporarily reversed. Given the respective income elasticities of demand for crop products, livestock products, and marketing services, it is highly likely that these historic declining trends will reappear in the course of future economic growth, unless foreign export demand for grains is especially strong.

The Marketing Sector

A much noted feature of the output markets for Canadian agriculture is the increasing importance of marketing boards. This is a manifestation of producers' efforts to follow a countervailing power philosophy of increasing the extent of their control and market power in the marketing of farm products. The result has been many different types of Canadian marketing boards with very different activities and effects.

The primary objective of most boards is to improve the price and income levels of their producers although the reduction of market uncertainty and of price and income fluctuations and the provision of more equal access to market opportunities are important to some boards. Boards can attempt to achieve enhanced price and income levels for their producers by demand expansion, by seeking efficiency gains, and (depending on the extent of their legislatively sanctioned powers) by the exertion of bargaining power. The potential benefits are often more obvious in the latter case, especially where these are extracted from consumers (if the board has effective monopoly power including power to divert or limit supplies) and from government (if the board is an effective lobbyist) although bargaining power gains may also be sought from the marketing and servicing sectors (where these possess and use oligopsonistic power).

Public controversy in Canada has centered upon the more restrictive supply-managing boards, particularly the boards for poultry and dairy products. These boards have limited supplies through quotas and have administered prices, generally on the basis of cost-related formulas. They have raised and stabilized their producers' prices although at the cost of increased consumers' prices, lessened export opportunities, adverse effects on allocative efficiency, and, in some instances, detrimental effects on the competitive characteristics of processing (Veeman and Loyns). The need to increase the extent of consumer and public accountability of these boards continues, whether through more public representation on them, or through limitations on the extent of their powers and effects (such as allowing competition from imports and limiting price increases when quota values rise to the excessive levels that now apply for some products).

The majority of Canadian marketing boards are less restrictive in nature. Although there are examples of inefficient and ineffective operations, a number of these boards have provided benefits of improvements in the price discovery process and in pricing efficiency, some off-setting of oligopsonistic power, and improvements in producer confidence in the marketing system. Economists' criticism of supply management boards should not be construed as an attack on marketing boards in general. Marketing boards can be effective policy instruments.

Turning to the other facets of the output markets for Canadian agriculture, it is apparent that the relatively small size of the domestic market and (except for the Montreal and Toronto areas) its wide geographic dispersion have significant effects on the structure and organization of the processing and distributing sector. Based on national concentration data (Department of Consumer and Corporate Affairs; Statistics Canada 1977), some one-third of the Canadian food and beverage processing industries fall into the category characterized by Bain as "highly concentrated," while the remaining industries can be categorized as "moderately concentrated" or "slightly concentrated." However, the latter two categories include such industries as meat, dairy, and poultry processors, frozen fruit and vegetable processors, fruit and vegetable canners and preservers, feed manufacturers, and bakeries for which national concentration data understate, in many instances grossly, the extent of regional concentration and of effective competition. Concentration in the processing of Canada's major nonfood agricultural product, tobacco, is high. Although comparison is not aided by the feature that the Canadian industries are more broadly defined than in the United States, concentration levels of the industries in this sector are markedly higher in Canada. Time series data in this area are scanty in Canada, but concentration in the Canadian food- and beverage-processing industries has shown an increasing trend over the past three decades (Department of Consumer and Corporate Affairs). As Morris has noted, the relatively high levels of concentration that prevail in this sector cannot be ascribed to product differentiation, lack of capital availability, or to the extent of economies of scale per se. An additional structural feature of importance is the high degree of trade protection which applies to many of the food-processing industries (Wilkinson and Norrie).

Evidence regarding the performance of the food- and beverage-processing industries (Food Prices Review Board) suggests that, except for the extremely concentrated sugar-refining industry, the average return on investment cannot be regarded as excessive (although profit rates of some industry leaders are considerably higher than the industry average rates). Nonetheless, there is evidence in many Canadian food-processing industries of relatively poor performance in terms of economic efficiency. There are widespread examples of lags in the adoption of technological advances and instances where available economies of scale are not achieved. Excess capacity is prevalent in a considerable number of these industries. The sector as a whole has a relatively low level of expenditure on research and development. The problem of unsatisfactory performance with respect to the achievement of economic efficiency is not confined to the food- and beverage-processing industries but is common throughout much of the Canadian manufacturing sector. As Safarian has pointed out, these limitations fundamentally reflect the relatively small scale of this protected market and of firm size.

Turning to the food-distributing sector, there is evidence (Dooley, Mallen) of high and increasing levels of concentration in the retail grocery industry. Backwards vertical integration by the major corporate chains into wholesaling and processing is increasing. There are significant regional differences in urban concentration levels and these are associated with differences in margins and prices. Mallen concludes that entry barriers to shopping center sites and the economies of local advertising are the causes of the relatively high concentration levels in this industry and that there are associated adverse impacts on performance of, first, higher profits and excess capacity (overstoring) which contribute to higher prices and, second, less product variety and less (free) service.

In contrast to the processing sector, markets for off-farm purchased inputs are largely unprotected by tariffs. Even so, this sector is also composed of oligopolistic industries. Economies of scale are extensive for a number of these industries (e.g., some farm machinery items, fertilizers, and agricultural chemicals) and have been a factor encouraging the development of multinational giants, most of which are foreign-based. There is a high import component for a number of these products (e.g., pesticides and farm machinery). Instances of imperfect market conduct are provided by the historical evidence of market separation and price discrimination towards the Canadian market for some farm machinery items (Barber) and the alleged price collusion by fertilizer companies (including a major Canadian cooperative).

The relatively small-scale and dispersed nature of the Canadian domestic market raise problems in the formulation of industrial policy. Within the limits of market size and given available economies of specialization and scale, high levels of concentration are inevitable in many Canadian industries. While this raises the problem of pricing inefficiency stemming from a high degree of market power, it by no means (as implied by the summary above) ensures attainment of technical efficiency. The prescription of increasing competition by reducing the levels of tariff and nontariff protection afforded the manufacturing sector is both obvious and long-standing. However, as the example of the largely unprotected farm input supply sector indicates, this is only a partial answer to the problem of formulating an adequate Canadian industrial policy. The (necessary) move to lowered levels of protection is constrained by concern over the extent of foreign ownership and control in the economy, the regional implications of less protection (not so evident in the food processing industries as with some other industries), and worldwide evidence of increasing protectionist tendencies. Given the current economic and political pressures facing the federal government, major changes in this area are unlikely in the short run and, in fact, added protection for some processed foods (fruit and vegetable products) seems likely.

The other facet of providing for enhanced competition is through reform of the historically weak Canadian antitrust legislation. Major legislative changes to this end were proposed seven years ago but were withdrawn and extensively revised in response to massive pressures from business. Consequent amendments to the legislation were made in 1975, but the most significant proposals for change are still pending. The revised competition legislation is unlikely to have any major effect on the existing high levels of concentration and may, in fact, sanction increased concentration levels where these are likely to increase technical efficiency (Stanbury). The legislation (including the proposed changes) does, however, have the potential to limit a wide variety of anticompetitive practices although only time will tell whether this potential is realized.

Foreign trade is the other significant component of the Canadian agricultural marketing sector. Some 40% of Canadian agricultural products are exported; these exports account for about 11% of all Canadian exports. Grains (particularly wheat) are the dominant agricultural exports. Agricultural imports account for some 8% of total imports. Nearly 30% of agricultural imports are accounted for by fruits and vegetables; sugar, tea, and coffee account for 18% and meats for 11% (1976).

Recent well publicized (but, to our minds, overly pessimistic) concern has been expressed by some agrologists that Canadian agriculture is losing its competitive position. It is the case that the Canadian manufactured goods sector has declined in international competitiveness—a feature which has been attributed by the Economic Council of Canada to excessive increases in unit costs, a lack of entrepreneurial initiative, and insufficient modernization of industrial structure (and these features may well apply to the fruit- and vegetable-processing industries). It is not, however, at all clear that there has been a decline in the competitive position of those agricultural products for which Canada appears to have a comparative advantage. The more pessimistic view of the trade performance of Canadian agriculture is based on the feature that there have, over the 1970s, been substantial increases in the importation of fruits, vegetables, and manufacturing beef and, more recently, increasing net imports of pork. These features have led to pressures to increase trade barriers for these products.

The trade deficit in pork which has applied since 1975 is largely explained by the more attractive market prices which have prevailed for barley sold as such since 1973. Together with the operation of the hog cycle, this feature is the basis of the downward movement in hog slaughterings (reversed in 1977) and of the regional shifts in the location of hog feeding away from the prairies. The level of imports of fruits, vegetables, and manufacturing beef is a more major and continuing question. There have been substantial increases in the per capita consumption levels of fresh fruits and vegetables and of beef in response to increasing real levels of income and taste changes. Imports of these products now account for a larger market share than in the 1960s, but there is no evidence from the available data of a consistent upward trend in the market share of these imports over the 1970s. In any event, relative to the major exporters of fruits, vegetables, and manufacturing beef, Canada is at a comparative disadvantage (except for cool temperature horticultural crops) in these products (Agriculture Canada 1977a, vol. 1, p. 23). On efficiency grounds, it is doubtful that a policy of further encouragement of import substitution should be condoned.

The primary agriculture sector has a low degree of protection compared to the manufacturing sector, but a tendency towards increased protection is evident and is increasing. In common with many, if not all, other countries, there is an ambivalent Canadian attitude to trade which involves the advocation of lessened trade restrictions facing the commodities for which we have a comparative advantage and a tendency to increasingly protect those commodities and activities for which we do not. Canada, especially western Canada, has a strong vested interest in promoting freer agricultural trade and our international bargaining stance to this end is weakened by our position with industries such as dairy products, fruits and vegetables, and, more particularly, the manufacturing sector.

The grains and oilseeds sectors are by far the most important in the context of Canadian agricultural exports. A major point of contrast between the United States and Canada is the system of centralized marketing for Canadian grain exports. The full benefits and costs of the two systems are difficult to compare (Schmitz and McCalla) although it is apparent that the Canadian system has contributed to stability and equity within the grains sector and is supported by the great majority of Canadian producers. There is, however, recognition and voluminous documentation of a number of problems and issues in the handling and transportation system. Major issues here concern the extent and the administration of rail-line abandonment throughout the prairies, the need for added investment in transportation and handling facilities, and the associated question of the extent and incidence of the benefits and costs involved in the statutorily determined Crow's Nest Pass rates which apply to grain moving to export positions. These issues have major implications for regional development. The Crow rate issue, in particular, involves complex equity questions and cannot be solved entirely on efficiency grounds.

To a considerable degree, the evolution, general prosperity, and policy concerns of Canadian agriculture in the 1980s will be tied to the nature and strength of foreign demand for Canadian agricultural exports. The future dimensions of the world food problem and the role for food exporters such as Canada and the United States are extremely uncertain. On the one hand, there are estimates by FAO, USDA, and IFPRI that the "dependence gap" between food production and effective demand in the poor nations is growing and may approach 72 million metric tons by 1985—with some observers reading into this scenario the likelihood of strong export demand for North American grains and rising grain prices. On the other hand, we note the relatively short-run nature of the recent world food crisis; the re-emergence of grain surpluses in exporting nations; the potential productive capacity of rich nation-agriculture, given strong economic incentives; the considerable growth but great instability of Russian agriculture; and the recent improved performance and self-sufficiency of Indian agriculture, aided by four consecutive good monsoons. Among Canadian observers, the Economic Council of Canada has rather pessimistic views and the Canadian Wheat Board, moderately optimistic views on future grain exports. Our own view of this uncertain picture is that Canadian grain exports will experience only modest secular growth, but will be very unstable. Although poor nations may face growing deficits in grains, Canada is more apt to face growing grain surpluses in the 1980s. A priority research task should be to gauge the relative strength of export demand in the centrally planned economies and the developing market economies.

Conclusion

The current structure and organization of Canadian agriculture has evolved out of a complex set of biophysical, economic, social, and institutional forces. In the future, the primary production sector will be characterized by fewer, larger, and predominantly family-oriented farms. The farm sector faces continued income instability and uncertain secular market prospects. A host of federal and provincial programs seek to reduce the extent or impact of price and income variability, but there has been a growing tendency for some of these programs to move into income enhancement on a commodity basis with little attention paid to income distribution consequences. Primary agriculture in Canada has evolved as a relatively efficient sector, but increasing policy attention must be paid in future years to questions of income and wealth distribution. The Canadian agricultural marketing sector is an increasingly concentrated sector. Canadian policy will be hard pressed to gain the advantages of technical efficiency in a small and dispersed market without extensive societal regulation to attain pricing efficiency.

Canadian agricultural and food policy must deal with many issues which we have not adequately discussed (see Loyns and Warley for recent domestic and international perspectives, respectively). One such issue is food price inflation, a major contributor to overall inflation in the Canadian economy at the moment. Increasing policy attention must also be paid to environmental considerations, land use planning, and increasing energy costs, although these aspects do not alter our basic judgment that Canadian agriculture is more constrained by demand than supply factors in the foreseeable future.

Solutions to Canada's agricultural and economic problems must be forged within the confines of our continuing debate on constitutional and national unity issues—including the questions of the possible separation of Quebec, the historic alienation of western Canada, and the evolving role of government in a federal state. Canadian policy must deal increasingly with regional considerations which involve the delicate balancing of provincial demands for more autonomous policy making and for further decentralization of services with the need for more indicative planning at the central level, greater harmonization of provincial programs (as with current "stabilization" programs), and the avoidance of balkanization in production and interprovincial trade. At a time when taxpayers seem to want less, and not more, government, the development of policy for agriculture will be no easy task.

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Agriculture Loses Its Uniqueness

Don Paarlberg

Some time ago a friend asked me, "What is the most important event that has happened in agriculture during your lifetime?" I put him off for a month while I reflected on this provocative question. Then I told him I had an answer which would take me forty minutes to deliver. He said, "I don't want to know that much about it."

So, from that time to this I have borne an undelivered speech. When Jim Hildreth invited me to give this lecture I wasn't long in accepting, and I wasn't long in naming a subject.

My subject is, agriculture is losing its uniqueness. This is a matter of profound significance, economically, socially, and politically. My contention is that, while we have perceived it in general fashion, it is time that we examine it in depth.

Historical Perspective

Years ago agriculture was basically different from other occupations. It was more a way of life than a vocation. Farmers were self-sufficient. They bought and sold little; they took to the market only what was in excess of their own needs. They had their own tradition, their own life-style. Farmers were readily distinguishable from other people by speech, dress, and manner. Farmers had much lower cash incomes than nonfarmers, and they had fewer conveniences. But these disadvantages were not so much the subject of invidious comparisons as they were the accepted attributes of a special way of life.

Farmers were considered uniquely worthy. The ideal was a nation of family farm operators, producing food, the most needed product of all. Farmers were considered God-fearing citizens, stalwart defenders of the Republic, and a stabilizing element in the society. Those who grew up in the country did not need to be taught these values; they absorbed them through their pores. This set of ideas was known by social scientists as agrarianism, or agricultural fundamentalism, or the agricultural creed.

There was much good-natured joking at the farmer's expense. He was readily recognizable in the cartoons, with his straw hat, his pitchfork, and his patched overalls. In poolhall conversations of that earlier day, the farmer usually had a daughter who had various adventures with traveling salesmen. Occasionally the farmer came to town and someone sold him the Brooklyn Bridge. But in the folklore of the day, the farmer usually got the best of the city slicker and we felt a warm glow about it, because we all thought he was a good fellow.

Reflecting this body of agrarian belief, the economy was delineated into farm and nonfarm sectors. If someone was born into agriculture and left it, the important fact was not whether he became a tradesman of a laborer; the important thing was that he became a nonfarmer, and among farm people there was some onus associated with the change. A farmer was disappointed if his sons turned to other occupations.

The farm-nonfarm delineation of the society was a logical grouping whether on economic, political, or social grounds. Farmers were different. They were unique, and worthily so. They knew it and so did everyone else.

These ideas are essentially philosophical, sociological, and political. The underlying thought was articulated by the English philosopher John Locke. It was organized into a coherent body of thought by the French physiocrats, particularly Quesnay. Agrarianism was powerfully advocated in this country by Thomas Jefferson, and has provided a continuing fountain of thought to the present day.

Because agrarianism is essentially philosophical, sociological, and political, few economists have addressed themselves to it directly. But some agricultural economists have dealt with it perceptively. Ed Bishop made

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Fellow's lecture.

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this the subject of his excellent presidential address in 1967. Jim Bonnen has spoken and written on the decline of agrarianism, emphasizing the implications for research, education, and public policy. Vernon Ruttan has addressed himself to it. Harold Breimyer and Phil Raup have dealt with the subject. John Brewster, philosopher-economist of the USDA, was intrigued with it. Kenneth Boulding, that multidisciplinarian, wrote and spoke effectively on agrarianism.

In addition to the work of these prestigious people there is what I would call a kind of economic subculture that has dealt with the subject. These people have sought to provide an economic rationale for agrarian belief. Carl Wilken and his lineal heir Arnold Paulson of Granite City, Minnesota (not Arnold Paulsen of Iowa) are prominent among this group.

While we, as economists, have seldom dealt directly with agrarian belief, we have been profoundly influenced by it. The idea of agriculture's uniqueness helped establish the institutions within which we work. The Department of Agriculture is a unique institution, originally set up to serve a unique clientele, the farm people. The land grant colleges were established as a direct assertion of agriculture's uniqueness. Not only did we set up schools of agriculture, we divided the scientific disciplines into farm and nonfarm categories. There was chemistry and there was agricultural chemistry, as if farm molecules were different from others. There was engineering and agricultural engineering, statistics and agricultural statistics. There was economics and agricultural economics. The experiment stations, the extension service, and vocational agriculture were all set up to serve a unique clientele.

The Agricultural Establishment

There sprang up what I shall call "The Agricultural Establishment." I identify four members of this establishment, all with their roots in agrarianism.

The Department of Agriculture. Its agrarian origins are verified by the inscription over the doors of the administration building, quoting Abraham Lincoln: "No other occupation offers so wide a field for the profitable and agreeable combination of labor with productive thought as agriculture."

The land grant colleges. I have already indicated how they divided the scientific disciplines on an agrarian basis.

The agricultural committees of the Congress. Anyone who doubts the agrarian orientation of these committees should reread Charles Hardin's "Politics of Agriculture."

The farm organizations. From the first, they have asserted agriculture's special deserving.

These four groups came together in a powerful assertion of agriculture's unique worthiness, based on agrarian belief. Their accomplishments were remarkable. Farmers were given preferred access to land and water. We voted price and income supports for farmers but not for automobile manufacturers or hardware merchants. Our tax laws favored farmers, as evidenced by the coming into agriculture of outside capital, attracted by tax advantages.

When general social legislation was enacted, we often excluded agriculture, because of its uniqueness. Consider some of the major exclusions sought by and originally granted to agriculture: (*a*) exemption from social security; (*b*) exemption from a whole set of laws related to hired labor: child labor, working conditions, minimum wages, workmen's compensation, collective bargaining rights, unemployment insurance; (*c*) exemption from laws regarding the restraint of trade, granted to farmer cooperatives; and exemption from the military draft.

Having achieved this preferred treatment, the attitude in farm circles was to treat it not as an indication of political favor, but as a form of deserved differentiation from the nonfarm sector. A farm leader or a farm politician would deny with his last breath that agriculture had received any favored treatment. The strategy has been to focus attention on those areas that showed agriculture at a disadvantage, to contrast the existing situation with some ideal, and to claim from government the full redress of the disparity. If the claim of agriculture's uniqueness would help in attaining this objective, the claim was invoked.

Some people say that preferential treatment was obtained by political power. Certainly there is some truth to this contention. But this political power was enhanced by agrarian belief and owed much of its success thereto.

Industrialization of Agriculture

I need not spell out for this group the advent of industrialized agriculture, which impacted agrarian belief and is destroying agriculture's uniqueness. The industrialization of agriculture has been the subject and to some degree the unstated objective of our profession from the beginning. I give quick review, to show how pervasive the changes have been.

There came the scientist, the technologist, and the engineer. There came the educator and the businessman. The tractor came, and with it a whole new complex of power machinery. The acreage that one man could handle doubled, redoubled, and doubled again. Farms increased in size and decreased in number. The farm population diminished.

Rural free delivery came, and with it a great expansion of the farm press. There came the radio, the telephone, rural electrification, and television. Now Landsat whirls around the earth with its remote sensing apparatus, looking down alike on farm and nonfarm phenomena.

The paved road and the automobile came. Soon thereafter came the school bus and the consolidated school, so that farm children no longer sat beside other farm children in a one-room school; they mingled with nonfarm children in the classroom and on the athletic field.

The isolation of rural life diminished. Farm people began reading the same papers as did nonfarm people, hearing the same radio programs, watching the same television stars, seeing the same commercials, wanting the same amenities. The alleged superiority of the farm way of life was no longer an acceptable offset for the lower incomes and fewer conveniences associated therewith.

Farmers began thinking and behaving like nonfarmers. Increasingly they borrowed money, rented land, and hired labor. Whereas farmers once supplied nearly all the factors of production, they came to buy more of their input items. Purchased fuel, feed, fertilizer, machinery, and other expenses now amount to 80% of the value of products sold. Farmers, originally producers of new wealth, have become much like manufacturers. In our concepts and our accounting, we should increasingly think of agriculture as we do of industry, in terms of value added rather than value of total product. Here, as elsewhere, delineation of the economy into farm and nonfarm sectors is becoming a distinction without a difference.

Changes affected families as well as production units. Farm wives gave up the kitchen garden and their canning projects—they bought groceries in the supermarket, like the city cousins. By degrees the farm family moved away from the older ideas of subsistence and self-sufficiency. Increasingly they entered the money economy.

The younger generation went off to school, and began choosing vocations in much the same fashion as their classmates from town. Formerly it had been assumed that the farm-raised young man would take over the home farm and continue the family name on the old homestead; this tradition gradually faded. Farm people began taking off-farm jobs. Part-time farming grew in importance. Farm wives entered the job market, as did women generally.

The changes were profound. From colonial times until well into the nineteenth century farmers had outnumbered all other vocational groups combined; by 1880 they became a minority. With the coming of the automobile, more and more nonfarm people became rural residents and farmers became a minority among the rural population; they are now outnumbered, six to one, in the rural areas. And a few years ago an incredible thing happened: the nonfarm incomes of farm people exceeded the farm incomes of farm people; sales of crop and livestock products became a minority source of income.

Farm people have entered the mainstream of American economic, social, and political life. They are no longer readily distinguishable from nonfarm people in speech, dress, or manner. The "city limits" sign, which was once an indication of economic and cultural differences, now simply marks the boundary between two units of local government.

Technology produced by the land grant college system was the engine that produced the change. It was the educational system, in the classroom and through the extension service, that helped homogenize the society. The institutions set up to serve a unique vocation have had the unforeseen consequence of reducing, indeed, almost destroying, that which they had set out to serve.

The trends were gradual, so that year-to-year changes were not particularly noteworthy. But they were cumulative and irreversible so that over time they were immense.

But, agrarianism is by no means dead. It persists, gradually declining through time, like the Geiger count for radioactive waste. What is the half-life of an outmoded agrarian idea? Maybe a generation, twenty or thirty years.

One is tempted to say that this experience shows the ultimate triumph of economics over the other social sciences, and that contrary to Keynes, practical men of affairs eventually win out over men of ideas. There certainly is some truth to such a view.

Agrarianism was strongly attacked by a number of prominent people: philosophically by A. Whitney Griswold, politically by former Secretary of Agriculture Earl Butz, and economically by almost our whole profession. The most effective attack on agrarianism came from agribusiness firms, with an assist from men prominent among us, especially John Davis, Earl Coke, and Ray Goldberg.

Agrarianism was defended, on economic grounds, by Wilken and Paulson, as I have said. It was defended politically by Jim Hightower and his colleagues from the Agribusiness Accountability Project, and by Clay Cochran, of the Rural Coalition. It was defended on sociological grounds by Walter Goldschmidt in his 1947 book, *As You Sow,* and by Wendell Berry in his new book, *The Unsettling of America*. More or less consistently, the defenders of agrarianism won on rhetoric and the attackers won on the body-count.

Changing Role of Agricultural Economics

The major institution on which I wish to focus is our profession, agricultural economics. It was created as part of the agricultural establishment. As originally conceived, farm people, with all their uniqueness, were the agricultural economist's clientele. What happens to a profession, set up to serve a unique clientele, when the clientele loses its uniqueness? What happens to the land grant college system, also created to serve a unique clientele? And to the Department of Agriculture, established within that same concept? The answer is that they either transform themselves or they atrophy, wither away, and eventually die.

How do we transform ourselves? The answer here is that we work on new subject matter, in research, teaching, and in extension. A new agenda is coming into being for agricultural economists. It is not an agenda that we have deliberately chosen; it is one that has been thrust upon us. Some, the farsighted ones among us, have seen it coming.

Some time during the early 1970s, while I was in the Department of Agriculture, the idea gradually began to dawn that most of the policy subject matter with which we were dealing had not originated with our farmer friends; it had been generated by nonfarm people. It may seem strange, in retrospect, that we were so slow in perceiving and even slower in acknowledging the obvious fact that the agricultural establishment had lost control of the farm policy agenda.

A brief rundown of the issues with which we then dealt makes clear this loss of power. Here were the policy issues of that time; they have not changed much since then: (*a*) Food prices, and specifically how to hold them down, an issue placed on the agenda by the consumers. (*b*) Food programs, especially food stamps, which grew until they took up much of the budget of the Department of Agriculture. This issue was placed on the agenda by what has become known as the "Hunger Lobby." (*c*) Adulterated food, which was the code word for foods produced or processed with the use of chemicals, put on the agenda by the natural foods people. (*d*) Junk food, the allegation that the food supply carried excessive amounts of sugar and starch, an issue put on the agenda by the nutritionists and consumer groups. (*e*) Ecological questions, placed on the agenda by the environmentalists. (*f*) Rural development, primarily a program for the 85% of the rural people who are nonfarmers. (*g*) Limitations on government payments to farmers, put on the agenda by a coalition of taxpayers, small farmers, and believers in limited government. (*h*) Land and water use questions, issues raised by those who opposed the long-held idea that farmers have first claim on resources. (*i*) Civil rights, advocated by those who challenged the white male tradition that has long characterized agriculture. (*j*) Foreign trade issues, raised by nonfarm people who wish to liberalize the quotas which limit the imports of beef and dairy products. (*k*) Energy issues, raised by nonfarm people who allege that agriculture is an inefficient user of fuel. (*l*) Occupational safety and health, written into law in behalf of laboring people. (*m*) Collective bargaining for hired farm labor, an effort to extend to this group the rights of group action enjoyed by others, an issue lifted up mostly by Cesar Chavez' United Farm Workers. (*n*) Reorganization of the U.S. Department of Agriculture, put on the agenda by the president with the help of a committee of experts in public administration. The USDA would be abolished or dismembered. The Forest Service would go to Interior, and the food programs would go to Health, Education and Welfare. Other agencies would pick up other pieces. These proposals were beaten back by a three-part coalition: the bureaucrats working from within; the lobbyists working from without; and the congressional committees working from above and below. But these proposals are not dead by any means.

What had happened was that as agriculture entered the mainstream of economic, political, and social life, the special privileges and the exclusive treatment of agriculture were eroded away. The loss of agriculture's uniqueness and the declining number of farmers meant that agriculture lost control of the farm policy agenda. In football language, the agricultural establishment had lost the ball. There is one thing worse than losing the ball; that is, to lose the ball and think you've still got it.

We were not as well-prepared as we should have been to deal with these issues. This was mostly a matter of mind-set. Some research had been done on these subjects, but we were not well able to use it. We had not anticipated the events of the new agenda and we were incapable of thrusting them aside.

Adapting to Change

I certainly do not want to exaggerate the changes I describe. They are far from complete. They have not come with dramatic suddenness. The old agenda is still important: witness the debate over an old issue, price and income policy, during the past twelve months.

At least some members of the old agricultural establishment will launch initiatives in the years ahead. Agricultural uniqueness will be asserted in support of these efforts: (*a*) higher targets and loans under the commodity programs; (*b*) preferential treatment with respect to foreign trade; (*c*) reservation of prime lands for agricultural use; (*d*) use of water for irrigation rather than for nonfarm purposes; (*e*) preferential treatment with regard to fuel; (*f*) exemption from environmental rulings; (*g*) exemption from price control; (*h*) continued exemption from labor laws; and (*i*) preferential tax treatment.

But, the case for agriculture's unique deserving gets harder to make with the passage of time. As professionals, we will have to decide how much attention to allocate, respectively, to the old and to the new agendas. How much water do we want to carry for the expiring case that agriculture is unique? That will be a troublesome question for agricultural economists in the policy field in the years ahead. My own view is that we need to shift some of our professional resources to the new agenda.

How well have we accommodated ourselves to the changes I describe? Some astute people have read the tea leaves accurately and have done research while the new issues were in gestation stage. Here is a partial list, which will omit many deserving people, but, despite such dangers, I name these persons and institutions as illustrative: Ed Bishop and Calvin Beale in rural development; Varden Fuller, on farm labor; Maurice Kelso, water problems; Marion Clawson, land use; Jim Hildreth and the Farm Foundation, with its studies on a number of new issues; Iowa State, with its Agricultural Adjustment Center; Lucille Kelley and Steve Hiemstra, food programs; Walter Wilcox, on the incidence of benefits from the big commodity programs; Gale Johnson, foreign trade; and the Economic Research Service, environmental problems.

Some of this work gave affront to the agricultural establishment but was done nonetheless and in the long run has proven advantageous even to those who were offended by it. During the 1940s, the Bureau of Agricultural Economics worked on a number of socioeconomic questions, resulting in budgetary retaliation against the agency (Hardin 1946). Nevertheless, the Economic Research Service, under the leadership of Quentin West, put added resources into researching the new agenda. Ken Farrell made a strong presidential statement at our annual meeting two years ago in support of across-the-board research on public policy issues. As administrator of the new Economics, Statistics and Cooperatives Service, he is carrying out the policies he recommended.

Thirty-five years ago T. W. Schultz did courageous pioneering work on the efficiency and the nutritive aspects of animal and vegetable fats which offended the agricultural establishment. Nevertheless the work stood up scientifically and reflected credit both on the author and on the profession.

The fact that the agricultural establishment resisted researching the new agenda indicates two things: one, that they confused research with advocacy; and the other, that they felt they had or should have had proprietary interest in agricultural economics research. If we gave reason for either of these beliefs, it is to our great discredit.

We must not be captured by any special

interest group. We have to keep probing to find out how far we can push into controversial issues. We have to keep shoving out the perimeter of knowledge. We have to believe that objective research ultimately has good results. I am reminded of the inscription over the door of Warren Hall, at Cornell University:

> Never yet share of truth was vainly set
> In the world's wide fallow.
> After hands will sow the seed,
> After hands from him and mead
> Reap the harvests yellow.

I think we have done better than we are willing to admit in adapting to the new setting and researching the new agenda subjects. This is a strange statement, but I believe it is true.

When change comes, our sister social scientists tell us, the process proceeds in this order: (*a*) Changed practices, induced by new technology. (*b*) Institutional adaptation, brought about slowly, unevenly and grudgingly. But for a long time the rhetoric continues to affirm the old order and even to deny that there has been institutional change. (*c*) Finally, full acceptance of change in all its aspects. But, I should add, in the meantime, technology has moved on several additional steps. The process of institutional and attitudinal change is never done.

The point is that the rhetoric in support of former things is continued long after technology has invalidated them and even after the changes have been accepted institutionally. In part this is a smoke-screen, and has its utility. Behind it and obscured by it, the necessary changes can be and are being made, with less offense than would be the case if statements fully reflected the facts. In this respect it serves a useful purpose and we should not be too critical of it.

Here I make a bold statement: The dispute over methodology which has absorbed the profession during recent decades has served as a lightning rod for controversy, permitting a needed agenda change to take place with minimal friction. While we argued about how to serve the meal we changed the menu, which seems to me to be more important.

The point is that if one wants to know what is going on, he should look at what is actually happening, rather than listen to what is being said. One might deceive himself if he listened too closely. So, if one wants to know what in fact is going on, he should adjust his "perceptors" in the following manner with regard to the following entities: the Department of Agriculture—pay less attention to press releases and more attention to the budget; the agricultural committees of the Congress—discount what they say and watch how they vote; the farm organizations—disregard what they say about the family farm and look at the composition of their membership; the land grant colleges—take less note of the agrarian rhetoric and pay more attention to their program of work; and the agricultural economist—be more impressed by what is used than by what is praised.

That we have, as a profession, made substantial shifts to accommodate the new agenda is evident from the content of our annual meeting. I made a count of the pages of our proceedings issues of thirty, twenty, and ten years ago, and also last year, dividing subject matter into old and new agenda items. I used essentially the same delineation as is used in the new three-volume survey of literature edited by Lee Martin. The shift toward new agenda items is clearly evident:

Year	Share of Space Given to New Agenda Items
1947	7%
1957	33%
1967	54%
1977	72%

Increasingly, departments of agricultural economics at the land grant colleges have been merged or blended with general economics, and with their sister sciences. Iowa was the first to do this; Minnesota did it more recently.

The change in our discipline has been difficult for the traditionalists, of whom I am one. For one thing, it means that some of our painfully acquired skills become obsolete. But, all members of the agricultural establishment have, to a degree, in their actions if not in their words, accommodated themselves to change.

The agricultural committees of the U.S. Congress have accepted environmental concerns and consumer causes as part of their subject matter; in fact, they have used these as carriers for the old commodity programs. The U.S. Department of Agriculture has accepted the new–agenda programs laid on it by the Congress. The farm organizations have abated what was formerly almost total opposition to nonfarm influences. The land grant colleges have broadened their research programs, their extension activities, and their classroom offerings; they now serve rural nonfarm and even urban groups. They have lost what was earlier almost a monopoly position on farm-related matters. Large farms and big agribusiness units are now recruiting from schools of business as well as from schools of agriculture. Operators of the larger farms increasingly get their technical information from the big firms that supply them with inputs, as well as from the extension service. The competitive grant programs for agricultural research outlined in the 1977 farm bill are not limited to land grant colleges.

The Future

What lies ahead? I can see nothing that will restore agriculture's uniqueness. There are feeble attempts to grow "natural foods," to set up self-sufficient communes, to reinstate an earlier form of the family farm, and to market direct from farm to consumer. While there will be individual success, these initiatives seem unlikely to alter the course of events in any fundamental sense. For better or worse, agriculture has entered the mainstream of economic, political, and social life. Economists generally say this is for the better; sociologists generally say it is for the worse. The politicians worry about it in their public statements and support it by their votes.

The farmer-producer and the agribusiness community will continue to need our services. But these services can hardly be rationalized anymore on a contention that agriculture is uniquely deserving. And these services will have to be supplemented by assistance to other participants in the food chain: those who supply input items, those nonfarmers who are concerned with the use of land and water, and those who consume the products that flow off American farms.

So far as research is concerned, our task becomes much harder. When you are part of the group that controls the agenda, you know what topics to study; they are the subjects you want to ready for the initiative which is yours to launch. But when control of the agenda lies elsewhere, you cannot anticipate the issues as well. This is the difference between offensive and defensive strategy. In considerable measure, agricultural strategy has to become defensive. Those who wish to fashion their research in support of the old guard must recognize that defensive strategy is different from what we have become accustomed to during the entire history of the profession up to recent times. Our resources are not so great as to permit them to be expanded on subjects that are unlikely to have relevance.

Conclusion

We often hear some change hailed as the "end of an era." But this change may in fact be what we now witness. Agriculture has been a unique vocation for unnumbered years. It is now losing that uniqueness.

How should one feel about this? One's reaction is, of course, subjective. As for myself, I feel a mixture of emotions. On the one hand is happiness that the former poverty, isolation, drudgery, and deprivation of farm life is being alleviated. On the other hand is sadness that farmers are being deprived of the sense of unique worthiness they once felt and are becoming an undifferentiated part of a homogenized society. I do not doubt that this accounts for some of the unease we witness in the farm sector.

From this throat comes one cheer, maybe two, certainly not three. But what difference does it make, whether there is one cheer, or two, or three, or none at all? The change is irreversible. To talk about restoring the uniqueness of agriculture is like talking about putting the chicken back into the egg.

I do not imagine that I am telling you anything you do not already know, or anything with which you will basically disagree. All I am doing, really, is to give public witness to a change that is too deep and too important to go unremarked. To observe it in silence would be like allowing the passing of a great man to go unmemorialized.

I close with a quotation from Omar Khayyam, a noneconomist who nevertheless was capable of sound empirical observation:

> The moving finger writes;
> And, having writ, moves on.
> Nor all your piety nor wit
> Shall lure it back to cancel half a line,
> Nor all your tears wash out a word of it.

It may be that I have merely confirmed the good judgment of my friend who "didn't want to know that much about it." But, in any case, I have relieved myself of an undelivered speech, the heaviest burden known to man.

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Consumers and Food Policy in North America

Carol Tucker Foreman

Thank you for inviting me to address this joint meeting of American and Canadian agricultural economists. Especially I want to thank my good and longtime friend, Sylvia Lane.

As a layperson, I was flattered by the invitation to address an audience of scholars. As a government official frequently dependent upon the quality, and even the quantity, of your work, I was delighted to accept. And since the day I accepted this invitation, I have been compiling my wish list of research projects.

Anyone who takes more than a cursory look at our more successful agricultural policies will see they have usually been based on the economic and policy research of people such as you. I applaud your past successes. But I come before you today to ask you for help in forging new successes: to turn more of your talents to public policy and social science research in the area of food and nutrition.

We meet at an exciting time for you and your profession. I feel relatively certain that none of you chose agricultural economics as a vocation in the fond hope that you would wind up as lead editorials in the *New York Times* or the *Wall Street Journal*. The agricultural economics *Journal*, maybe; not Wall Street's.

But you may have been wrong. Food is news today. And two interesting and important things are happening right now—both of which involve you.

First, the traditional debate over "agricultural" policy has been expanded into a debate over food and nutrition policy. We are no longer concerned only with the mechanisms for producing, processing, and distributing food, and the kinds of economic returns that are available to producers, processors, and distributors. Within the past few years, the traditional agricultural arena has been enlarged to include a debate over food composition, nutritional values, chemical additives, and costs to consumers. And these new issues may have an enormous impact on the economic returns of producers, processors, and food retailers.

Second, we have reached a point in our national life when the people of this country, while still willing to use government action to attack a wide variety of problems, are quite rightly unwilling to tolerate unforeseen, unintended, and unfortunate consequences of those actions. We are, it seems to me, in desperate search of competence in government.

Both of these developments are of enormous importance to your profession. You, in turn, can play a crucial role in resolving the problems which they present.

The Food and Nutrition Policy Debate

First, let us look at the debate over a food and nutrition policy. It is interesting to me that it is a debate. Does anyone, anywhere raise food for its own sake? Or because the plants look so pretty popping out of fields?

We produce, process, package, and market food so that people will buy it, eat it, and be nourished by it. In food, more clearly than in any other sphere of the economic world, the consumer is the sole end of production.

But, until recently, government food policy has tended to be overwhelmingly concerned with increasing production, improving processing, and enhancing distribution. These are good and worthwhile aims! At one time they were the only things we needed to be concerned about. Today, however, they ignore some very crucial problems. Let me outline some of the most pressing.

We have for years used chemicals at various points in the food system to increase production, retard spoilage, and preserve foods. They seemed a stunningly successful solution to those problems. Now they are presenting problems themselves as we learn that some of the same chemicals, which had such appar-

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ently beneficial effects on food, treat the human body rather less kindly.

We have become so dependent upon food processing and upon nationwide food distribution systems that the farm value of production in some cases bears little relationship to the final costs of food.

Although millions of Americans are still unable to get enough to eat without public assistance, millions of others have nutritional problems that result from consuming too much.

For those who simply cannot afford an adequate diet, the usual "solutions"—nutrition research and education and food safety regulations—are irrelevant.

Another problem area involves the dramatic change in American lifestyles over the past fifteen years. Educators and nutritionists alike are becoming increasingly concerned about the capability of consumers to make food choice decisions that provide nutritionally sound diets.

Finally, we know that government policies encourage and discourage certain kinds of production and marketing systems through support prices, research, and regulation. But we know little about the impact of these programs on nutrition and on consumer prices.

Government must deal with these problems. The goal that I would seek involves the development of an integrated set of policies that will provide for an adequate supply of safe, high quality, and nutritious food at reasonable prices, while providing a reasonable return on investment to those who produce and distribute food, and assuring some assistance to those at home and abroad who cannot afford an adequate diet even at reasonable prices.

Competency in Government Requires Research

Obviously, no one program will achieve this goal. It requires a mixture of public and private action. Perhaps more than anything it requires wise, rational, well-conceived public policies. Which brings me to my second point—the need for competency in government action. You and your professional cohorts hold important keys to competency in government action.

When I look back over some of the issues I have wrestled with since entering the government eighteen months ago, the potential for your influence and the need for your expertise is overwhelming. The gaps created by their absence are sometimes appalling.

For example, in food assistance programs, one of the very first issues that confronted us was the debate over President Carter's welfare reform program and whether food stamps should be "cashed out."

We know that food stamps account for about $6 billion a year in federal tax dollars, going to some 16 million people each month. However, with the exception of the work done by Sylvia Lane and a few others, we have little research on the impact of the food stamp program. We have little empirical data on the impact of a "cash out" on the nutritional well-being of food stamp families, on the total purchase of food, or on the prices received by farmers.

There is not much research on school feeding programs either. To a greater and greater degree, schools want processed foods. They do not want whole chickens. They want pre-cut, pre-breaded, pre-cooked frozen chickens because that reduces labor costs for the school. But what impact does that have on the producer? What impact does it have on the budget of the program at the federal level and the state level? What impact does it have on the nutritional adequacy of the school lunch?

Let me talk for a moment about superdonut and its friends. There is a perfect example of the need for your expertise.

The superdonut is a formulated grain/fruit product. It is used in the school breakfast program to take the place of both the cereal/bread and vegetable/fruit portions of the breakfast. Usually a school must serve a three-component meal. With this product, only two components are necessary. But, there is no fruit in the grain/fruit product. It is a donut or cupcake fortified with vitamins and iron. It is also high in sugar and fat.

It was originally introduced in order to encourage schools with no cafeteria facilities to take part in the breakfast program. But, we now know that most of the schools which use it have cafeterias. It is a convenient way to save money on school breakfast. But its use means that vitamin C manufactured in a laboratory is substituting for vitamin C manufactured by a citrus farmer. Further, the superdonut may be teaching children that a sugary, high-fat product is an appropriate item to have for a nutritious breakfast. Surely, it increases the child's sugar and fat consumption.

These are unintended, unanticipated, and unfortunate results of a government action taken to resolve one problem. It did not resolve that problem. It potentially created new ones. That probability could have been and should have been foreseen. It might have been if there had been adequate analysis before we started to use them. Research on this issue did not exist until the recent work by a group of analysts in USDA's Economics, Statistics and Cooperatives Service (Boehm and Matsumoto).

Is the superdonut a trivial issue? It is typical of child nutrition problems, and child nutrition programs cost $3.5 billion per year.

Let us take another example.

No issue has been more hotly debated in the agricultural community over the past couple of years than the Senate Nutrition Committee's dietary goals (United States Senate). Nutritionists are debating the scientific validity of the goals. Cattle producers are screaming that the goals portend their economic ruin. Do they?

I do not know. You have not told me. I am not aware that you have written about the potential economic impact on cattlemen if consumers follow the guidelines, and you have not analyzed whether cattlemen might gain economically from less grain feeding. To my knowledge you have not written about whether the production of leaner cattle would increase consumer prices, reduce imports of lean beef, or any of the other myriad possible results. To my knowledge you have not analyzed the costs to society of time lost from work as a result of diseases that may be diet related.

Every time new nutritional and dietary information comes to light, the affected industry dissolves in hysteria and develops symptoms of acute paranoia. Egg producers, or hog farmers, or cattle raisers are sure the government is out to get them and that they are going to be driven out of business. Their very natural reaction is to attempt to refute the scientific data or prevent any attempt to act on it. That is normal and natural.

It may also be unconscionable in terms of national health. But worst of all, it may be a great waste of energy. Perhaps the recommended changes will not cause great economic dislocation. We will not know unless we have the research. Even if change must come, public policy can be shaped to reduce the burdens of that change—if we have the research and analysis that provides the policy options.

Let me turn for a moment to regulatory decisions and the absence of economic data on which to base our actions. Nitrite is a good example. The USDA and the meat industry have known for ten years that the sodium nitrite used in curing meat is implicated in the formation of cancer-causing-nitrosamines. We know that this causes the meat to be adulterated under the Meat Inspection Act. The impact on the industry and the public may be very great. But I cannot find any economic or policy research, except a little done by the affected industry, on the extent of that impact, or on policy strategies that will help us comply with the law and reduce the impact on the industry and the public.

I believe strongly that we must act to protect the public health through vigorous enforcement of food safety laws. I am not much persuaded when the economic health of an industry is used as the only argument against an action to protect the physical well-being of the public.

However, we can and should choose the public policy alternative that reduces the economic impact, or at least spreads it as broadly and equitably as possible. To do so requires development of policy alternatives based on economic research.

The Need for Action

These problems are not going to go away. They are going to increase and in the absence of solid research it will be increasingly difficult to make good policy judgments.

Two years ago your former president, Ken Farrell, gave an address to this Association in which he urged you to expand the vision of your field (Farrell). He chided you then for failing to address the most important policy problems in the food system.

I frequently seem to follow Ken's lead and so I guess much of what I have said today has the ring of "Amen, Brother." Not without reason. I read your *Journal* from time to time. And I have looked in vain for results of research relevant to the new food agenda. Perhaps you have expanded your research programs and policy analyses since Ken's speech, but I must confess I have seen little evidence of it. I was, though, pleased to see some food and nutrition items on your agenda here.

I hope you agree that a two-year gestation period is long enough. Even an elephant delivers after twenty-four months. And who wants to be more ponderous than a pachyderm?

In the past and even today you might plead that you have lacked sufficient funds to do this work. It is a legitimate complaint. Secretary Bob Bergland, Howard Hjort, Ken Farrell, and I are working to end that.

The USDA's $5 million competitive grants program for human nutrition research includes for the first time a category for funding studies relating to the social science aspects of nutrition. In addition, the Secretary has noted the need to devote increased resources to the various agencies within USDA responsible for economic research and policy analysis of food and nutrition related issues. Clearly, we are committed to do more than has been done in the past to free money for research on such issues.

A Research Agenda

Now, you know we need you and you know we are willing to come up with some money. Next comes my "wish list" of the research we need. I hope you will consider devoting resources to some of the following areas.

Basic Research on Factors Affecting Food Choice

First, we need to know a lot more than we do now about the intricate web of factors that make people decide what foods to buy and eat. Singly, and in combination, we should evaluate the influence of education, income, race, region, sex, age, advertising, labeling, and lifestyles on food choice. We should also determine how all these factors and resulting choices relate to health and to farm income. It would also be useful to identify the relationship between the consumer demand for nutrients and the demand for marketing services. Conceptual developments in this area are as old as your profession, but have you gotten much beyond a conceptual understanding?

This research can provide the foundation for policy analyses and evaluations of federal programs in nutrition education, food labeling, and food quality regulation. It would also help us understand the nutrition–related consequences of federal agricultural production, marketing, and income stabilization programs.

Research to Determine the Consequences of Changing Technology

Nutritionists contend that food industry practices, including advertising, are important factors in nutritional decay. In large measure these industry practices are a reflection of, and are encouraged by, technological changes in food processing and retailing. We badly need economic research to evaluate the extent to which these changes actually result in lower per unit costs for consumers. What good is all this technological advance if consumers do not benefit through lower costs?

Economists have long recognized the important trade-off between technical and pricing efficiency. Now we need research to document the magnitude of the relationship. Fritz Mueller and his colleagues believe that inadequate competition in retail food markets results in substantial "monopoly overcharges." Others point out the weaknesses of these studies. We must get beyond the point-counterpoint stage.

Research in this area must also deal directly with the economic consequences of such practices as the use of universal product code (UPC) and electronic funds transfer (EFT), vitamin fortification, and the proliferation of packaging. It must also deal with the costs and benefits of economic regulation on industry practices. Backhaul regulations would appear to be an obvious case in point.

Analysis to Determine the Impact of Food Safety Regulation

The third item on my agenda would be analyses to determine the impact of food safety regulations. Surely you can sense that one of the most frustrating aspects of my job at USDA has been the lack of research on the economic impact of various food safety alternatives. Research of this type could help us ease the burden of changing government policies on food system participants.

Research in the Area of Food Quality

The fourth item, research in food quality, is probably the one most familiar to agricultural economists. Most of the present food grades and standards are products of the agricultural establishment. But are they meaningful to today's consumers? Do consumers even know what the grades mean? Evaluation of present regulations is badly needed and I cannot encourage too strongly the initiation of such research.

Food Assistance Research

Finally, it is essential that we know more about how our various domestic food assistance programs actually contribute to nutritional improvement and to the support of farm income, other than just encouraging the consumption of surplus products.

"Cash-out" of food stamps appears to be postponed at least for now, but Congress did pass legislation last September to eliminate the purchase requirement for food stamps, and to extend its benefits to an estimated 3 million more needy people. Now is the time to initiate research on the effects of that change. The questions will not go away.

The new law, by the way, improves both the program's accessibility and its accountability and has improved the structure of administration enormously.

In addition to the school breakfast and lunch programs, the Women, Infants, Children food program (WIC) has perhaps the greatest potential to use food and nutrition to improve health. It provides prescription food packages to vulnerable persons at nutritional risk during the most critical phase of human growth and development—that is, to pregnant women, nursing mothers, and young children.

WIC legislation was not part of the Food and Agriculture Act of 1977, but amendments are pending now in the Congress. It is important that we research both the nutritional contributions of all these programs and their effect on food purchases generally because they affect people who cannot afford an adequate diet, and because they are taxpayer-supported. I do not have to tell you that we need to get the most out of our government's money.

Concluding Remarks

That's a pretty hefty agenda. I present it to you because I believe agricultural economists have the tools and the training to resolve many of these complex issues. Or, at the very least, to shed light rather than heat on them.

To do so will, of course, require an investment of human capital. You will have to learn as much about food and nutrition programs as you already know about commodity prices, income supports, and marketing order programs. But you will be playing a very large role in a very important decision-making process.

I ask you to seize the moment. If you do not, the work will be relegated to analysts who know little or nothing about agriculture. I do not want that to happen, and I do not think you do either. But surely you understand that we will decide and we will act. The absence of good data to help resolve a problem does not make the problem go away.

We in government who carry a responsibility for human nutrition programs do not like to pull and tug at the scientific community. We would much rather follow you. John Dewey once wrote that "every great advance in science has issued from a new audacity of imagination." Or one could simply say, "Behold the turtle, he makes progress by sticking his neck out."

I hope you will help us proceed in a more rational fashion to deal with food and nutrition issues.

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North American Food and Agricultural Policy: Conflict and Cooperation—A General Introduction

Alex F. McCalla

This panel discussion devoted to food and agricultural policy in Canada and the United States is appropriate for a joint meeting of the two associations. In fact, at previous joint meetings, similar topics have been addressed. In 1967, papers by Wilcox and McCalla addressed the implications of U.S. farm policy for Canada. In 1973, papers by Brandow and Gilson addressed "conflicts and consistencies" between U.S. and Canadian policy. Despite these earlier forays, the ever-changing character of food and agricultural policy makes it still professionally interesting to compare again policies in two countries related by history, geography, and economics. Further, in the area agriculture, the two countries are partners and competitors in international agricultural trade. The purpose of today's panel is to analyze the various facets of food and agricultural policy in both countries and the interface of "North American Food and Agricultural Policy" with broader world markets.

By way of introducing the panel, it is useful to review briefly the historical evolution of the two countries' agricultures and the policies pertaining thereto. Some general notion of the importance of trade, both between Canada and the United States and in international markets, will help set the stage for my distinguished colleagues who will present brief statements before we open the floor for general discussion.

The Historical Evolution of Agricultural Policy

In the brief period 1760–76 the settled portion of what later became Canada and the United States were under common rule. However, even prior to that period, the patterns of settlement in eastern North America were similar. Thus, it is not surprising that the early evolution of policies relating to agriculture showed remarkable parallels. Wilcox, Cochrane, and Herdt note that the dominant concern of agricultural policy in the United States prior to 1862 was land distribution and ownership. Drummond, Anderson, and Kerr argue that preconfederation (1867) policies in Canada were concerned primarily with exploitation of agricultural land as a means to general expansion and export stimulation. Thus, early agricultural policies in both countries were viewed as means to national economic development.

The evolution of policy in both countries between 1850 and 1930 also show similarities in the stages of policy evolution. The period 1862–1910 saw a continuation of expansionist land settlement policies. The Homestead Act in the United States (1862) and the Canada Dominion Land Act (1872) provided the impetus for the western movement of agriculture in both countries via the mechanism of the 160-acre homestead. While the American West filled more rapidly than the Canadian prairies, practically identical land distribution policies left similar legacies of subsequent problems.

The second phase of agricultural policy can be characterized by policy concerns with productivity and efficiency in agriculture. In the United States, the Morrill Act (1862) and the act creating the U.S. Department of Agriculture (1862) began the emphasis on education and research. In Canada the Bureau of Agriculture for Upper and Lower Canada was created in 1852. Explicit attention to agricultural research in Canada was formalized in the Experimental Farms Act of 1885; while in the United States, it was embodied in the Hatch

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Act of 1887. The third element of the now famous triumvirate—extension—came in Canada in 1913 with Federal Grants to the Provinces for extension. The United States counterpart was the Smith-Lever Act of 1914.

Farmers in both countries were concerned with monopoly exploitation by railroads and "big business" in the 1880s and 1890s. Both countries adopted various kinds of policies to improve market efficiency and product quality in the period 1895–1920. Concern with access to inputs, particularly credit, emerged on the policy agenda in the teens and 1920s.

As each successive stage of policy evolution occurred, previous policies stayed in place. Thus, agricultural policy became an increasingly complicated overlay of previous policies which were constantly being augmented. These policies relating to settlement, productivity, market efficiency, and access to inputs can be characterized as nonmarket or noninterventionist policies, despite the fact that one of their implicit objectives was to improve farm income.

The 1920s saw an agricultural depression in both countries. Governments, through policies relating to cooperatives and marketing boards, were willing to lend their authority to assist farmers in attempting to gain market power and influence prices and income.

However, the total accumulation of policies reviewed above did not mitigate the difficulties brought to North American agriculture by the Depression. Thus, the 1930s saw significant changes in the character of agricultural policy in both countries. The United States, in particular, starting with the Agricultural Adjustment Act in 1933, embarked on increasingly comprehensive and expensive policies of direct market intervention involving production controls and price supports which, in various forms, have continued to the present. The Canadians were less ambitious in direct attempts to support farm income, perhaps because of a lesser treasury and a greater dependence on international markets. Nevertheless, the Canadian Wheat Board (1935) and the Agricultural Prices Support Act of 1944 represented direct market intervention attempts to bolster Canadian farm incomes. Canadian government involvement in price and income support has increased since these early actions.

I have presented this brief historical scenario primarily to illustrate that the patterns of policy evolution have been similar in both countries, as one might expect from historic, geographic, and economic commonalities. But more important, they provide hopefully some basis for looking at the current set of interrelationships that the panel is to discuss.

Trade Interrelationships—Bilateral and with Third Countries

The parallels in policy development outlined previously also stem from important trade interrelationships between Canada and the United States. An article by Bray provides details on recent Canadian-U.S. trade. In recent years over 55% of Canadian imports of agricultural products have come from the United States. The two largest items in value terms are fresh and preserved fruits and vegetables. In 1977, U.S. exports to Canada totaled $1.6 billion—less than 10% of the value of total U.S. exports. Canadian agricultural exports to the United States totaled $672 million in 1977, representing 17% of total Canadian exports but less than 10% of U.S. imports. The largest item in this trade is live cattle. Thus, bilateral trade flows between the two countries are significant but not overwhelmingly important in the total agricultural trade of each country. However, for certain commodities such as fresh fruits and vegetables and live cattle the Canadian-U.S. bilateral flow is dominant.

A second form of international interface occurs in third country export markets in which both the United States and Canada participate. Here the joint importance in world markets is very important. In wheat, for example, Canada and the United States combined have in the last twenty years consistently accounted for around 60% of world exports. In feed grains, the United States and Canada again provide more than 60% of exports, but U.S. exports far outstrip Canadian. Thus, certainly in the grains, the two countries can have potentially large impacts on world markets. To the extent that domestic agricultural policies influence export policy, there are indirect interrelationships between the two countries' agricultural policies.

This brief summary of the evolution of policies in the two countries and the degree of interaction in international markets was meant to provide a background for the meat of this morning's discussion. Our panelists have been assigned topic areas for discussion. On the panel we have two Canadians and two Americans and, as chairman, a Canadian who lives in the United States. Let me briefly indicate the areas of discussion.

The first panelist, Howard Hjort, will discuss policy goals and objectives in both countries, identifying conflicts and consistencies and discussing implications for third countries. Gale Johnson will discuss the character of actual policy, or the policy means used in both countries. In particular, he will discuss the role assigned to the market in each of the policy set. Elmer Menzie will discuss input policies pursued north and south of the 49th parallel. Finally, Walt Anderson will discuss trade interdependencies both in terms of intercountry trade and in terms of Canadian and U.S. exports and imports to and from third countries.

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U.S. and Canadian Food and Agricultural Policies: Goals and Objectives, Conflict and Cooperation

Howard W. Hjort

A similar set of economic, physical, and political factors have forged similar goals for U.S. and Canadian agricultural policy. This article will address those policy goals and compare the conflicts and consistencies between them and the approaches the United States and Canada have taken in their handling of domestic and international affairs in order to realize those goals.

Within the last decade, both the United States and Canada have witnessed a turbulent series of agricultural events—extreme variance in world agricultural production, wildly fluctuating prices, the entrance of the Soviet Union and other countries into the world market, an increased awareness of the consumer, rising food prices, and overall inflation.

To cope with these events, both the United States and Canada developed agricultural policy goals covering four broad areas. Very similar in their nature, the goals are: to provide a fair return to producers, bring supplies in line with demand, avoid extreme fluctuations in prices, maintain long-term benefits to producers, and encourage orderly marketing; to provide an adequate and dependable food supply that will ensure high quality, nutritious foods at reasonable prices; to liberalize trade, expand exports, and provide technical assistance and food aid to developing countries; and to improve the quality of life by caring for natural resources, supporting extension activities, and sponsoring research.

While the policy goals of the United States and Canada are similar, the agricultural systems the two countries have developed are different. Both have "free market systems;" but in its producer-oriented programs, Canada has relied more heavily on government management of food and agricultural markets to reduce instabilities. Canadian policy tools include price, income, and production stabilization programs for livestock and crops, including income and price supports, deficiency payments as profit stabilization measures, marketing boards and quotas, administered prices, and import controls.

Founded on the belief that the general public must share with farmers the burdens of risk in agricultural production, the dominant theme for Canadian agricultural policy has been increased public commitment to the enhancement of stability in farming. Canada's crop insurance program is an example of that theme because farmer premiums are subsidized in large part by tax revenues.

Canadian policy encourages increased productivity and efficient marketing to reduce the per-unit costs of production, even to the extent of providing freight assistance to producers.

The Canadians also have given increasing consideration to national policy objectives and the effects of food and farm policies on consumer interests. Just as in the United States, Canadian food policy makers have assumed that by protecting the producer and thereby maintaining assured, dependable supplies affecting price stability and the even-flow of goods, the consumer will ultimately benefit.

In addition, earlier this year Canada announced its development of a "food strategy." According to this policy, the government will concentrate on the competitiveness of the food-processing industry—monitoring its performance and enhancing its productivity and efficiency. As yet, no new programs have been developed.

Canada's food strategy assumes that consumer interests will be represented adequately in marketing and production boards and agencies. However, it does not include domestic commodity distribution or food assistance

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programs like those in the United States; these are instead considered a part of welfare programs and handled accordingly.

Canadian policy provides little direct government involvement in food price subsidies for consumers. But it does protect Canadians from bread price rises brought on by heavy exports and help assure an adequate diet for its citizens through its two-price wheat program.

The United States has relied upon a free-market system with less direct government intervention than the Canadian. U.S. views of food and agricultural policy also have been broadened to develop goals consistent with national objectives and to consider the interdependence and interests of all groups—producers and consumers, livestock and grain producers, exporting and importing nations, developed and developing countries—in an effort to balance more equitably both benefits and hardships.

Government involvement in U.S. food and agricultural programs has been focused mainly at the ends of the marketing chain—at producers and consumers—with the government playing an indirect role in marketing only for a few commodities such as fruits, vegetables, and milk.

Producer-oriented programs include a voluntary production adjustment program for wheat, feed grains, and cotton, income and price supports for most crops, and the farmer-held grain reserve for wheat and feed grains. These programs help bring supplies in line with demand, strengthen prices, and assure that the United States will remain a dependable supplier to its domestic consumers and to its trade partners, even in years when production is down.

Unlike Canada, the United States does not provide direct aid to livestock producers excepting milk producers. Instead, the United States provides only indirect aid to the livestock sector through its market price support programs for grains.

Like Canada, the United States has adopted stringent grading and inspection programs to ensure high quality standards for food. Both countries, committed to assuring consumers safe foods, have recognized the possible effects of chemicals and additives on food safety.

Both countries try to encourage their citizens to maintain nutritionally-balanced diets and use research and education programs to inform their citizens about nutrition. To help all its people obtain adequate diets, the United States maintains domestic food assistance programs. Through its largest food assistance program—food stamps—needy recipients may choose and purchase food at grocery stores through the stamps, thus supplementing their income for food. The National School Lunch Program provides 25 million children with reduced-cost lunches under the policy objective of increasing the nutritive value of the meals.

While policy goals are fairly consistent in the two countries, they tend to come into conflict in the international spectrum because national, economic, and political concerns play a major part in determining objectives and priorities in foreign affairs.

The world has become increasingly dependent upon the United States and Canada as the major suppliers of food. Together, the two countries provide the bulk of the grain trade world-wide and over a fifth of total world agricultural exports. Agricultural exports are vital to both the United States and Canada, contributing to farm and national economies and helping assure farmers of a fair return. Canadian agricultural exports were valued at \$4.2 billion last year. U.S. agricultural exports last year reached \$24 billion.

Trade between the two countries is also extensive, even though the kinds of commodities exchanged are often produced in both countries. However, because of its climate, Canada must rely to a larger extent on the United States for some commodities, especially fresh fruits and vegetables. The interdependence of the two countries is illustrated in that after last year's freeze damaged the Florida citrus crop and caused prices to climb, the food component of the Canadian CPI rose accordingly.

Thus, just as both countries are affected by the policy decisions and supply-demand conditions of North America, they are at the same time competitors and are interdependent of policy decision and supply-demand conditions of the rest of the world.

Recognizing the importance of trade on their national economies and food and agriculture goals, both nations have developed international policies to liberalize trade for their individual and mutual benefit. Both have been active in the General Agreement on Tariffs and Trade; and, in the current round of Multilateral Trade Negotiations, they have exchanged requests to reduce tariffs and duties.

In addition, both have stated they are willing to accept an agreement providing for consultations and exchange of information among countries on their domestic meat policies.

There also exists cooperation between the United States and Canada with regard to a new International Wheat Agreement. The U.S. commitment holds to a framework for fair and stable growth in world wheat trading. Its basic proposal has been for cooperative actions by importers and exporters to help maintain, but not fix, prices within a range.

Central to this plan is the U.S. proposal for an international system of nationally held wheat reserves for assuring greater price stability and supply security in the world market.

Canada has backed such a reserve plan. However, in keeping with its domestic grain policy, Canada favors measures such as stock and production limitations if the reserve mechanism alone does not keep prices within desired limits.

For coarse grains, the United States has strongly opposed an international arrangement for grains that might provide an inflexible and too-narrow price range to adjust to world supply-demand conditions and that might set a price floor which would hurt the U.S. competitive position.

However, international price floors for grains, market sharing, and global supply management programs intended to stabilize the international market tend to reflect Canadian measures growing in prominence in their domestic grain policy. The difference between the countries on the coarse grains question may lie in the greater relative importance of a single commodity—wheat—on Canada's agricultural, regional, and national economies.

Recognizing the benefits of assured markets through bilateral agreements, both the United States and Canada have used the bilateral approach. Canada has a bilateral arrangement with the People's Republic of China and with others. The United States has a formal agreement with the Soviet Union and informal bilateral arrangements with others, including its largest customer, Japan.

Moreover, both have tried to increase their access to international markets through further market development. Both countries have realized that long-range planning is vital to build the necessary, sustained increase in demand for farm products.

Both countries provide export credit to facilitate sales in foreign countries. At present, both have up-to-three-year credit programs. Canada also has a ten-year program similar to the intermediate credit programs we offer through the Export-Import Bank. The United States, through P.L. 480, has a long-term credit program of twenty to thirty years for selected countries. Congress is considering a bill to increase U.S. authority for an intermediate export credit program.

Besides commercial sales, both countries have pledged to provide food aid to help feed the world's malnourished. However, because a permanent solution to the problem of world hunger can come only from increased production and increased buying power from food-deficit, developing countries, both the United States and Canada have increased their commitment for technical assistance to developing countries.

Both the United States and Canada have recognized the importance of developing policies that will direct natural resource programs toward meeting current and projected demands for food, fiber, and environmental quality. And, because the natural ecosystems are largely mutually dependent, it is especially important for the countries to work together to derive programs to preserve them.

Such cooperation exists in the International Joint Commission in caring for, making wise use of, and preserving natural resources. Under the Water Quality Agreement of 1972, both countries are working to reduce nonpoint source water pollution in boundary waters we share. Both countries are jointly working to preserve their wetlands and have established policies to ensure that the migratory birds of North America will have mating and nesting areas.

In addition, both are working at home to study development of a viable land use policy. Because Canada's lands best suited for farming and human habitation are limited and in competition, it may have to address the question of farm lands versus urbanization more rapidly than will the United States. Nonetheless, the United States is also working on developing a land use policy as a means of protecting resources vital to meet both short- and long-term needs of the nation.

In a more traditional sense of research, both the United States and Canada are working under an agreement to do remote-sensing research to gather better information on crop production.

In the areas of research and ecology, the

National Agricultural Policies and Market Relations

D. Gale Johnson

The domestic agricultural policies of the United States and Canada have far more similarities than differences. Except for dairy products and sugar (and peanuts in the United States), both have price policies that keep market prices at moderate levels, at least by comparison with most other industrial countries. Both protect agricultural producers by direct payments for many products when market prices fall below some politically determined level. While the agricultures of both countries are dependent upon exports as a market outlet, both directly control the imports of some farm products, such as dairy and beef, and indirectly influence imports of other products through subsidizing their production. Thus, while both press for reductions in trade barriers by other nations, both follow some domestic and trade policies that are nearly as restrictive as those of the European Community and Japan.

There are, of course, some differences in domestic policies. The Canadian Wheat Board has monopoly control over trade in grains produced in the Prairie Provinces and part of British Columbia, both internally and externally. Canada is currently relying on direct payments more extensively than the United States with substantial direct payments to producers of dairy products, sugar, beef, sheep, hogs, feed grains, soybeans, and a number of fruits and vegetables. In contrast to the United States, Canada makes a significant effort to limit dairy production while the United States undertakes to engage in supply management for the major grains and cotton.

Agricultural economists should be more than a little chagrined that both countries now depend upon measures of production costs to determine price support or target levels. Few agricultural economists, if any, south of the border paid any attention when in 1975 the Canadians introduced changes in production costs into the formula determining their support levels. Thus, most of us were caught by surprise when the present U.S. administration and Congress so fully embraced cost of production as the primary guide to support or target levels. Our failure to understand that contagious diseases can move either way across the border left us incapable of mounting a defense against the use of an economically indefensible concept.

Establishing Support Levels

For Canadian grains there are two price support systems. The most important system is that administered by the Canadian Wheat Board for the Prairie Provinces and part of British Columbia. This system may or may not involve a significant subsidy or distortion of market prices. Farmers receive an advance payment for their grains; if the payment is set at a level higher than that realized from the sale of the wheat, the payment becomes the price that influences production decisions. There is a strong presumption that the Wheat Board is to break even (approximately) on its operations, returning to farmers what it realizes from the sale of the grain delivered to it.

The other price support system, which applies to several farm products in addition to grains, is based on the 1975 amendments to the Agricultural Stabilization Act. It was this Act that included the provision for inclusion of changes in production costs as part of the guide for establishing support levels. This legislation covers grains produced outside the Wheat Board area as well as major livestock products and various fruit and vegetable crops for all of Canada. The Act sets the support level (basically the U.S. target price) at a minimum of "90 percent of the previous five-year average price, plus the difference between current cash costs and the previous five-year average cash costs of production" (Agriculture Canada, 1977[a]).

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In the United States the grain target prices have been set (approximately) equal to average national costs of production, including a return on land of 4%. In terms of changes in the target prices for 1979 through 1981, the target price is supposed to be changed in accordance with an unduly complicated formula for changes in variable production costs per unit of output.

The Canadian support levels have some advantages over the American, if one is interested in minimizing resource use distortions. Over time the Canadian levels will reflect changes in the relative market prices for the commodities included in the Agricultural Stabilization Act. This is because the relative support levels will be influenced by a five-year moving average of market prices. Since deficiency payments are used to assure the support levels, market prices will not be directly influenced by the support levels, though there will be some indirect influence.

In the United States it is uncertain, of course, how target prices will be determined after 1981; given the administrative actions taken to establish target prices for barley and grain sorghums and the increase in the 1978 wheat target price in the Emergency Agricultural Act of 1978, it is even uncertain how they will be set between now and 1981. Assume that the administration and congress are through tinkering with target prices for the grains until there is new farm legislation in 1981. And assume, further, that the new legislation continues to use the national average cost of production as the criteria for establishing target levels. The target prices for 1982 will be higher than those based on the 1977 Act, perhaps by a significant percentage. The current return on farm land is probably below 3.5%; thus the continued use of 4% of current land values to determine the land component of the cost of production will result in a significant inflation of the target level. And, if the reduction of risk due to the price certainty assured by the target prices and the disaster relief provisions of the farm legislation results in a lower current return than 3.5%, the target price levels for 1982 and after will have even less relation to reality than did those now prevailing.

The use of cost of production after 1982 will mean that the new relative target prices will reflect the relative target prices that prevail between now and 1981. The classical economists said that price equals cost of production; it is even more true than cost of production equals price. With small adjustments for the cost effects of set-asides and land diversions, the relative costs of production will track the relative target prices in the years ahead. Thus, corn will continue to have a target price close to its market price, while wheat will continue to have a target price substantially above its market price and its contribution to the national product.

Storage Policies

Both the United States and Canada have storage programs for the major grains. In Canada the major decision maker with respect to grain storage is the Canadian Wheat Board, which has a great deal of discretion in determining the magnitude of grain in storage through its control over the pricing of grain for export. In the United States the amount of grain stored at any time has been left, to a considerable degree, to private storers operating within guidelines established by legislation and the administrative discretion established by the secretary of agriculture.

Briefly, the United States now has three main mechanisms for influencing the amount of grain in storage. One is the nonrecourse loan program which reflects the impact of the loan rates under the price support programs. Crops stored under this program may either be redeemed, delivered to the Commodity Credit Corporation (CCC), or placed in the farmer-held extended reserve program. The second mechanism is the extended reserve program which is substantially subsidized.[1] The third mechanism is the emergency reserve program for 6 million tons of wheat and an unspecified amount of feed grains for meeting foreign aid commitments and disaster relief.

When first announced, the extended reserve program was limited to 35 million tons; this limit was removed in late March. However, as of July 1978, the amount of grain in the reserve was less than 15 million tons. Loans may be redeemed when market prices reach 125% of the current loan rate for feed grains and 140%

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[1] Annual storage rates were increased from 20¢ to 25¢ per bushel in February for all grains except oats; the rate for oats was set at 19¢. If the grain is sold within the appropriate price bands or delivered to the CCC at the end of the period of the loan (three to five years) the farmer will not have to repay the storage cost and may well have all the interest forgiven. In any case, there is now no interest charged after the first year.

for wheat; the loans will be called when market prices reach 140% of current loan rates for feed grains and 175% for wheat. For 1978, the ranges are $2.50 to $2.80 for corn and $3.29 to $4.11 for wheat. While there is any grain in the extended reserve program, the CCC cannot release any grain that it holds at less than 150% of the loan except under the Emergency Livestock Feed Program. As I have argued elsewhere, one of the objectives of the reserve program is to increase the degree of price instability (Johnson). It is no longer intended that U.S. agricultural price policy is to result in relatively stable prices. The primary reason for the change was to reduce the resistance to farmers to the accumulation of substantial reserve stocks of grains which, under prior rules covering CCC disposition, had resulted in the price supports becoming price ceilings, at least for long periods of time.

I have emphasized the U.S. reserve programs because they introduce a new element into the international market for grains. For the moment, the program appears to have had the effect of increasing market prices. While the amount of grain in the reserve is small, it is obvious to participants in the market that the amount in the reserve could increase rapidly. There is virtually no cost or risk to a farmer in putting grain into the reserve—the storage payments are quite liberal and the real interest cost is negative. The current loans under the program are for three years, which will carry all of the loans beyond the 1980 presidential election. Under the legislation, the loans can be extended to five years, and presumably will be if market prices do not reach the release level in the next few years.

How will the Canadian Wheat Board react to this new element? We already know how Canadian farmers are reacting; they have increased their 1978 wheat plantings significantly over 1977. While it is not always possible to predict the behavior of the Canadian Wheat Board—after all, Canada increased stocks of wheat somewhat during 1973/74—it seems reasonable to assume that Canadian wheat stocks will be reduced in the years ahead as they were during 1977/78. And why not? If the United States is once again willing to accept the role of residual supplier, especially for wheat, other exporters are likely to accommodate us. This is especially true because the extended reserve program may serve primarily to disguise the long-run adjustment problems that face wheat in the United States and other major exporting nations (Johnson).

Domestic Policies and International Trade

Both U.S. and Canadian agriculture are greatly dependent upon exports, and thus both will gain from reducing barriers to international trade in farm products. However, in spite of the natural and economic advantages that their agricultures have compared to the rest of the world, each insists on protecting certain farm products. Some of the protection is through price supports, but there are also direct controls over trade. In terms of the sizes of the sectors, trade restraints are most important for beef and dairy products. Both countries heavily protect sugar. Canada, at least, does try to limit the expansion of its dairy sector and the amount of products that it must dump abroad. However, Canada appears to have been more liberal in its dairy price support level than has the United States. In 1977/78 the net return on manufactured milk in Canada appears to have been C$10.66 compared to something under US$9. Yet Canada has reduced milk production over the past three years while U.S. milk production has increased. Canada has achieved a production reduction through establishing a national quota and imposing a handsome tax (C$7.00 per hundredweight) on above-quota deliveries (Agriculture Canada, 1977^{b}). Canada also imposes a levy on in-quota deliveries to pay part of the cost of export dumping, an idea that we might consider in the United States.

Both countries weaken their efforts to achieve more liberal world trade in farm products by their use of import quotas and the protection of certain key farm products. Both have direct payment programs that induce higher output than would result from market prices, though the United States currently has some programs that moderately restrain output for major crops. It is not clear, however, that the combined effects of substantial direct payments for wheat, barley, and grain sorghums and the set-asides and diversions result in an output lower than what would be achieved by sole reliance upon market prices.

Concluding Comments

Canada and the United States are low-cost producers of many agricultural products. Together they play a major role in international trade. However, neither country can be said to have devised a consistent agricultural policy that makes the most efficient use of their agricultural resources. It is true that the trading world for agricultural products is a relatively hostile one, replete with beggar-thy-neighbor policies that result in an inefficient use of the world's agricultural resources and much greater instability in international prices than is necessary.

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North American Food and Agricultural Policy with Respect to Agricultural Inputs: Conflict and Cooperation

Elmer L. Menzie

While Canada and the United States have shared similar economic and cultural backgrounds, the dominance of the giant in all phases of Canadian life does lead to some conflicts of interest. Mexico has much less of an identity problem relative to its neighbor, because political, social, and cultural backgrounds differ significantly, but economic differences pose much greater problems and sources of friction.

The following focuses primarily on the Canadian-U.S. relationship involving policy on agricultural inputs. The discussion centers on policies relative to land, labor, energy, technology, institutions, and miscellaneous production inputs such as machinery and chemicals.

Land Policies

Canadian and U.S. land policies have emphasized both expansion and development, with individual family ownership. An overriding emphasis on efficiency of resource use and declining food costs has brought similar transformations to both countries. Recently, specific land policies, particularly in the United States, have evolved from an abundance of agricultural production. The decision to withdraw substantial acreage to maintain price support programs obviously had benefits for producers in Canada, Mexico, and other competing countries by helping to reduce market supplies. However, the associated stimulation of production through more intensive use of land and improved technologies, had an offsetting effect. Accumulated surpluses became an obvious source of friction worldwide.

Land ownership policies have also created some conflict. Mexico tends to be very restrictive and does not permit foreign ownership of coastal lands. Policies toward foreign ownership in Canada have been relatively liberal. However, the Canadian provinces exercise power over real property sales. Saskatchewan and Prince Edward Island prohibit foreign holdings above a stated level. Registration of alien investors is required in Ontario, Alberta, and Nova Scotia. Ontario also levies a special tax. Similarly, while the United States generally has had a liberal policy on foreign ownership, various states in the United States have laws that discriminate against foreign land ownership. Statistical data on foreign ownership in the United States are poor, but it has been estimated the total area was less than 1% of the 1.3 billion acres of private land in 1975 (Wunderlich).

Labor Policies

All countries practice restraint on immigration and, when levels of unemployment are relatively high, the restraints become more severe. Canadian policy generally is to hire Canadians first. The last two or three years have resulted in significant reductions in immigration, and much more rigid enforcement of hiring rules.

Some seasonal workers enter Canada each year, largely from the Caribbean and Mexico. These have been declining, and it appears Canada Manpower and Immigration expect the program to be phased out, although considerable resistance to this policy has been expressed by some Ontario producers. Grain harvest crews originating as far south as Mexico are no longer able to obtain Canadian work permits.

In the United States, there was practically unlimited entry for western hemisphere nations until a quota of 120,000 was imposed in

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1968. All western hemisphere countries were limited to 20,000 annually in 1976.

The more restrictive immigration policy will undoubtedly add to the frictions associated with the much greater problem of illegal entry, largely from Mexico. There is a demand in the United States for Mexican laborers, particularly in agriculture, and the wide disparities in income levels between the two countries attracts them to the United States. Entry restrictions have thus resulted in a major increase of illegal entries. There were 90,000 illegal Mexican aliens apprehended in the United States in 1966 and 781,000 in 1976 (Fogel). An additional 85,000 illegal aliens originating in other countries, including Canada, were apprehended in 1976. The total number of illegal entrants is unknown.

Water and Energy Policies

The Canada-U.S. International Joint Commission has had a history of nearly seventy years resolving common problems associated with boundary waters. A prime example of cooperation is in the joint development of the Great Lakes and St. Lawrence seaway for transportation and other uses. Currently the Commission is working on recommendations for reducing pollution of the waterway by agricultural chemicals and other industrial wastes. Other major areas of cooperation in water developments are associated with the Columbia River in British Columbia and border states, the Garrison Dam project in North Dakota, and the Poplar River projects in Saskatchewan.

Canada continues to be a source of various forms of energy for the United States. Inputs of capital, technology, and management have flowed relatively freely into Canada for energy development. Exports of crude oil to the United States from Canada have been declining as a result of Canadian policy to protect domestic supplies. Imports declined from 50% of refinery supplies in 1975 to 35% in 1977.

Areas of conflict have existed relative to the dominance of ownership and control of Canadian energy sources by external companies, largely from the United States. Restrictions on crude exports and the doubling of export prices for natural gas to the United States have created conflict in recent years. Nevertheless joint efforts continue between the two countries for both exploration and delivery of gas and oil from points in Alaska and Northern Canada.

Considerable conflict has developed over energy policies since the OPEC countries introduced new pricing policies in 1973. Escalating costs of energy have been a problem for developed countries but a disaster for many of the energy-short developing countries. Because North America is a major energy consuming area, the problems of shortages and escalating prices are considered to be largely a function of this area's affluence and waste. While conflict exists with the OPEC countries over their pricing policies, there is sympathy for the wealth transfers occurring, but little for the position of the developed countries.

Direct Production Inputs

"The farm machinery market is a highly concentrated, North American-wide industry. The supplies and prices of machinery are determined in this larger market" (Moore). Over 80% of Canadian trade in machinery is with the United States. Four multinational firms produce a major share of the supplies for the Canadian market. Only one of these firms is Canadian owned.

Trade between the two countries is free. However, some friction occurs resulting from the policies of the U.S. companies of producing most of the machinery for the Canadian market in the United States. Canadians also feel machinery designs would be better suited to local needs if more of the machinery were produced in Canada. It is recognized, however, that the Canadian market is relatively small and that significant economies of size exist in the industry, largely unattainable without the multinational market.

The fertilizer and chemical industries are also largely owned and controlled by multinational corporations, and trade between Canada and the United States is basically free. All of the phosphate rock used in Canada is imported from the United States and about two-thirds of the Canadian potash is exported to the United States. The Saskatchewan government takeover of about one-third of that province's potash production capacity has created some concern in the industry.

Almost all of the ingredients for manufacture of Canadian pesticides come from the United States, Europe, and Japan. Some disturbance has resulted from recent regulations preventing Canadian farmers from purchasing pesticides in the United States, unless they are Canadian-labelled or registered. There is dissatisfaction over the duties imposed on shipments to the United States from Canada, while chemicals enter Canada duty-free.

Policies on Technology

There has been a relatively free exchange of ideas and information between Canada and the United States while language, cultural, and political barriers have placed greater limits on exchange with Mexico. As result of the free-flow policy, Canada and the United States have shared technological progress. Scientists from universities, governments, and industry share ideas and developments through conferences, papers, talks, and private discussions. Students from Canada, Mexico, and other countries of the world study in the United States, and to some extent the reverse occurs. Aid programs of developed to developing countries have expanded the exchange of people and ideas to all areas of the world. There is a free flow of books and other publications.

These policies of generally free exchange are not free of conflicts, however. Recent tightening of Canadian immigration policies is creating some friction and constraining the free flow of information by restricting the movements of individuals. Patent laws do restrict the distribution of information, at least for a period of time. Conflicts of interest can and do occur where distribution of important developments are limited and made costly to satisfy selective private interests. Recent proposals to reduce the length of patent exclusiveness in Canada from seventeen to nine years is certain to create problems if accepted. Attempts will surely be made to secure patent rights in the United States where the protection is longer and therefore, greater.

There is widespread belief that foreign ownership and control has limited Canada's competitive position by limiting research and development by industry. Undoubtedly, branch plants located in Canada do little of the parent company's research regardless of the country of origin. When the battle for markets intensifies, the branch plant may not even fully share in its parent company's technologies. Canadian-based firms may find it to their advantage to cooperate with larger external firms to obtain greater returns to research expenditures. The United Cooperatives of Ontario, for example, funds research projects in the United States for this reason.

Institutional Policies

Institutional developments in both Canada and the United States provide significant opportunities for experimentation and observation. The experiments in systems of retention of agricultural land in British Columbia, Saskatchewan, and California are examples. The Saskatchewan land bank retirement and resettlement scheme is another, as are various land withholding schemes in the United States.

Ontario has tried and successfully employed the Dutch auction and a teletype system for selling hogs. Experiments with marketing boards in Canada should provide some insights into the problems and consequences of supply management, central marketing agencies, bargaining associations, and other forms of group action. Results of marketing agreements and orders in the United States and programs in rural development in both countries can and do provide guidelines for policy development elsewhere.

Concluding Comments

Relationships among the countries of North America tend to be relatively amicable. As evidenced by policies related to agricultural inputs, a significant level of cooperation exists. Greater advantage could be taken of these successful experiences to improve relationships in other areas. Similarly, each country could gain by taking more advantage of experiments in institutional and operational arrangements.

Most conflicts tend to be a function of misunderstandings, ignorance, or greed. Unemployment is a major cause for international friction. In Canada multinational company policies and charges of unfair competition by other countries are cited as prime factors in unemployment. This conclusion leads to the growth of protectionist policies. Producers and laborers demand price supports, import protection, and controls on foreign investment and immigration. These actions, if taken, generally accentuate the problem, leading to even more nationalism and isolation.

The world is now faced with increasing pressures from individual countries or areas for isolation. In ignorance, the choice may be to succumb to these pressures. The challenge before us all is to try to bring understanding to prevent such a disastrous course of action.

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North American Food and Agricultural Policies: Conflict and Cooperation—Trade Interdependencies

W. J. Anderson

Within the terms of reference of this panel, to explore conflict and cooperation in North American food and agricultural policies, I propose to introduce a few points concerning conflict and cooperation in the trade interdependencies associated with the trade between Canada and the United States, and with the relationships of the two nations with the rest of the world in commercial sales of food commodities.

The magnitude of the agricultural trade interdependency between Canada and the United States in 1977 was as follows: the United States imported $700 million worth of agricultural commodities from Canada and exported $2.0 billion worth to Canada. To put those numbers in perspective, Canadian exports to the United States amounted to 16% of total agricultural exports, while the United States sold 8% of its agricultural exports to Canada. Viewing this trade as imports, 58% of Canadian agricultural imports came from the United States, while 5% of the agricultural imports of the United States came from Canada.

Obviously, the impact on Canadian agriculture of the agricultural trade between the two countries must be greater than in the case of the United States. Moreover, because of the difference in the size of the two economies, the relative impact of this trade on the Canadian balance of payments is also greater than on that of the United States. It is also generally true for individual commodities that Canadian production is smaller so that a given volume of trade has a greater impact on the Canadian than on the United States commodity group. While the data suggest that Canadian producers would be more sensitive to trade issues, the fact is that producers in both countries are extremely sensitive to the impact of imports. A recent demonstration of this sensitivity was the attempt last spring by some producers in the United States to prevent physically the legal importation of cattle from Canada.

Another element which enters into the relative impact of trade in the two countries is that the climatic range in the United States permits production of a number of commodities which cannot be produced in Canada. The list includes citrus fruits and all fruits and vegetables when not in season in Canada. The result is that a large part, probably half, of the United States agricultural exports to Canada are produced at an absolute advantage.

On the other hand, hardly any exports by Canada to the United States are produced with resources that are unique to Canada. Thus, Canadian producers of export commodities view United States producers as competitors and, of course, United States producers reciprocate. For example, both Canada and the United States produce large amounts of grain for export. The nature of the resource base and costs probably are sufficiently similar to preclude major trading in grain between the two countries, but neither country encourages even local sales across the border that would minimize transportation costs. Canada gives the Canadian Wheat Board the power to control imports of major grains except corn and the United States maintains effective tariff barriers.

The potential for conflict and restriction is also illustrated by the sequence of responses, affecting the beef trade, to measures designed to achieve other policy objectives. In February 1973, Canada suspended tariffs on beef and live cattle as part of general, temporary tariff reductions which were a feature of the anti-inflation program. On 29 March 1973 the United States, also fighting inflation, imposed price ceilings on red meats, and on 18 July

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1973 removed the ceilings except for beef but announced that the ceiling on beef prices would be removed in September of that year. Beef producers in the United States therefore withheld livestock from the market pending removal of the price ceiling. Because the ceiling did not apply to imports, the policy stimulated large purchases of Canadian beef by buyers from the United States. Because of the large size of the United States consumer market, these purchases had a major impact on beef prices in Canada inconsistent with the anti-inflation program. Consequently, Canada imposed temporary controls on the export of red meats, limiting exports to the historical record. In mid-September, the United States removed the price ceilings on beef; Canada removed the export controls and restored the normal tariffs on beef and cattle. In November 1973, Canada imposed an import surtax of 3¢ a pound on live cattle and 6¢ a pound on fresh beef to protect producers against the decline in beef prices in the United States resulting from the large number of cattle marketed after the removal of the price ceiling. The tax was phased out by the end of February 1974.

By March 1974 the full impact of the steep rise in grain prices threatened widespread bankruptcy of feedlot operations, so Canada paid a subsidy on Grade A cattle and in August set a support price level for beef cattle along with import quotas. In November the United States announced retaliatory quotas on live cattle, hogs, beef, and pork from August 1974 to August 1975. Meanwhile, there was temporary trade disruption over the DES certification problem which arose when the United States—which, like Canada, had banned its use—changed its policy. Both countries removed the quotas on live cattle and the United States also removed its quotas on hogs and pork in August 1975. Both countries continued control of beef imports in 1976. These controls were necessitated by distortions in world beef markets and affect primarily beef imports from Australia and New Zealand, but the traditional reciprocal trade in beef between the United States and Canada has also been affected by these actions.

Harmonious, cooperative trade interdependency between the two countries is likely to result only when the matching of production possibilities with the market opportunities leads to substantial visible benefits to both parties without causing serious adjustment problems for politically sensitive segments of the industry in either country. Political-economic issues generated by competing commodity interests and from the goals of agricultural policy are important bases of conflicts in trade interdependencies. The temptation to adopt restrictive trade practices to support programs designed to achieve desired levels of price and income stabilization is strong because the results are visible, while the benefits foregone from failing to exploit the comparative advantages of the resources of the two countries are less apparent. Supply management, which is a feature of agricultural policy in both countries, fosters conflicting rather than cooperative trade interdependencies; the same is true of the achievement of returns based on cost of production, which is a potent political issue on both sides of the border.

Given the conflicts in trade interdependency inherent in the sensitivities, competition, and the goals of price and income policy, it is not surprising that trade issues between the two countries are continuously in the process of resolution, and that Canada-United States agricultural trade is not large if trade in those commodities which have an absolute advantage is not counted. Nevertheless, during past trade negotiating sessions, there has been significant tariff harmonization between the United States and Canada, to the extent that tariff barriers for a number of commodity groups have been abolished completely.

A strong cooperative element of Canada-United States trade interdependencies lies in the common interest of the two nations in expanding the world market and seeking an elimination of trade-distorting measures and a greater liberalization of world trade for agricultural products in general and for cereals and oilseeds, in particular. The barriers to expansion are the national policies of countries which restrict the overall amount of the world commercial trade in agricultural commodities. Many developed countries maintain highly protected agricultural sectors and, on occasion, subsidize the export of surpluses which the protectionist policy generates. Internal political pressure in these countries to abandon the high cost food policy is not strong, possibly because the price of food is not so critical to people in countries which enjoy high and rising real incomes.

The adoption of policies for economic growth by developing countries is another dimension of Canada-United States common interest. Given the importance of assuring food supply, developing countries may choose policies directed towards self-sufficiency in food that may be inconsistent with comparative advantage instead of encouraging (say) labor intensive manufacturing, the products of which would provide the exports earnings for continued agricultural development and the purchase of food. Cooperation between Canada and the United States in assisting developing countries to increase export earnings would assist them as well as serve the common interest of agriculture in our two countries. It is particularly important to provide assurance to developing countries that the risks of large price variability and periodic product unavailability in agricultural commodity markets would not be too great.

The development and maintenance of sales of agricultural commodities to the centrally planned economies is conditioned by their generally strong commitment to attaining self-sufficiency in food. They may, therefore, be expected to seek their own self-interests and be in and out of international agricultural commodity markets as yields and grain prices change.

It seems, therefore, that Canada and the United States have much to gain from adopting a common approach to market development in the Third World, to applying pressure against protectionist policies of developed countries, and to meeting the uncertainties of purchases from the large, centrally planned economies. In particular, Canada and the United States would gain from stabilizing the world grain market through an international agreement on a policy for holding stocks and through progress in liberalizing agricultural trade through multilateral trade negotiations.

The conflict of interest in external trade has appeared in the matter of holding stocks of grain in times of soft markets, as in the 1960s. Canada has been accused of benefiting from United States supply management through acreage set asides during the late 1960s and early 1970s. Maybe so, but Canada also undertook a massive and costly wheat acreage reduction program in 1971. Clearly, the lesson is that more consultation and cooperation under the circumstances would have been mutually beneficial.

So, I conclude that as Canada and the United States look outward toward third countries, the reasons for cooperation rather than conflict are substantial and the benefits of achievement are real. I do not find the same area of common interest in trade interdependencies between the two countries.

Can Human Nutrition Be the Leading Goal for Food and Agricultural Policies? (Sylvia Lane, University of California, Davis, Chairperson)

What Is Known about Human Nutritional Needs

H. S. Olcott

I have seldom been faced with a more formidable challenge than to give a short review of this topic. The field is immense, the literature overwhelming, public interest is intense, and demands to "do something" about nutrition come from all segments of society.

In the simplest terms, we are talking about the requirement of the human machine for fuel—partly an energy problem. Unfortunately man cannot utilize coal or petroleum or solar energy directly but depends instead on plants and on animals that also utilize plants. The chemistry and biochemistry involved in the nutrition of animals (including man) have become understandable only in the last few decades. Primarily we need proteins, fats, carbohydrates, and, in smaller amounts, vitamins and minerals. But these categories can be broken down to fifty or sixty separate items necessary for optimal nutrition. We do not know what "optimal" means for man. Goal choices are: fast growth, athletic ability, resistance to disease and toxins, mental health, and longevity, all reasonable goals; but we simply do not know if they require the same relative nutrient intakes.

Table 1 lists the recommended daily allowances (RDA) for some nutrients about which most nutritionists agree. These tentative recommendations, as of 1974, were revised from a previous list, published in 1968, and are again being revised for release in 1979. Individuals require differing amounts of nutrients as they mature from infancy to childhood, through puberty to adulthood and old age; pregnancy and lactation changes demand. In addition, the requirements will vary with size and, in amounts not yet understood but with considerable variability, from individual to individual. The RDAs are for healthy individuals. Groups suffering from various ills have different requirements. Hence the table can be used for the barest approximation, especially as we continue to learn that there may be additional factors not yet identified. The listing of required nutrients has led some to the thought that if a little is good, more will be better; so we must consider both the upper and lower limits for each amount. Some vitamins, for example A and D, and many minerals are damaged if ingested in large amounts. Harm could result if several different kinds of foods are fortified and consumed.

Thus we see that a general outline of what humans require is available and we know within limits the amounts of each nutrient needed. However, we eat food, not nutrients, and our concepts are colored by the acceptability of the food available. Food technologists are sometimes criticized for paying more attention to color, flavor, and texture than to nutritional content; but, in the long run, unless the food is consumed, it does not matter what nutrients it contains. All of us are, or should be, working toward the provision of attractive foodstuffs with optimal nutrient content. The science of food technology is advancing rapidly and these goals can be accomplished if the impetus is strong enough.

One method of stimulating changes in the nature of the food intake has been the actions of the Senate Committee on Nutrition and Human Needs chaired by Senator McGovern. Numerous hearings resulted in the dietary goals shown in table 2. There was no unanimity of opinion regarding the wisdom of trying to change the American diet as proposed in the first version. The second was drawn up in response to criticisms of the first. They suggest roughly: cut down on calories, meat, fat, sugar, and salt, increase chicken and fish, cereals, and fruits and vegetables. Details are still being argued vociferously. I may predict,

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Table 1. Food and Nutrition Board, National Academy of Sciences–National Research Council Recommended Daily Dietary Allowances, Revised 1974; Designed for the Maintenance of Good Nutrition of Practically All Healthy People in the U.S.A.

								Fat-Soluble Vitamins				Water-Soluble Vitamins							Minerals						
	Age (years)	Weight (kg)	Weight (lbs)	Height (cm)	Height (in)	Energy (kcal)[a]	Protein (g)	Vitamin A Activity (RE)[b]	Vitamin A Activity (IU)	Vitamin D (IU)	Vitamin E Activity[d] (IU)	Ascorbic Acid (mg)	Folacin[e] (μg)	Niacin[f] (mg)	Riboflavin (mg)	Thiamin (mg)	Vitamin B_6 (mg)	Vitamin B_{12} (μg)	Calcium (mg)	Phosphorus (mg)	Iodine (μg)	Iron (mg)	Magnesium (mg)	Zinc (mg)
Infants	0.0–0.5	6	14	60	24	kg x 117	kg x 2.2	420[c]	1,400	400	4	35	50	5	0.4	0.3	0.3	0.3	360	240	35	10	60	3
	0.5–1.0	9	20	71	28	kg x 108	kg x 2.0	400	2,000	400	5	35	50	8	0.6	0.5	0.4	0.3	540	400	45	15	70	5
Children	1–3	13	28	86	34	1,300	23	400	2,000	400	7	40	100	9	0.8	0.7	0.6	1.0	800	800	60	15	150	10
	4–6	20	44	110	44	1,800	30	500	2,500	400	9	40	200	12	1.1	0.9	0.9	1.5	800	800	80	10	200	10
	7–10	30	66	135	54	2,400	36	700	3,300	400	10	40	300	16	1.2	1.2	1.2	2.0	800	800	110	10	250	10
Males	11–14	44	97	158	63	2,800	44	1,000	5,000	400	12	45	400	18	1.5	1.4	1.6	3.0	1,200	1,200	130	18	350	15
	15–18	61	134	172	69	3,000	54	1,000	5,000	400	15	45	400	20	1.8	1.5	2.0	3.0	1,200	1,200	150	18	400	15
	19–22	67	147	172	69	3,000	54	1,000	5,000	400	15	45	400	20	1.8	1.5	2.0	3.0	800	800	140	10	350	15
	23–50	70	154	172	69	2,700	56	1,000	5,000		15	45	400	18	1.6	1.4	2.0	3.0	800	800	130	10	350	15
	51+	70	154	172	69	2,400	56	1,000	5,000		15	45	400	16	1.5	1.2	2.0	3.0	800	800	110	10	350	15
Females	11–14	44	97	155	62	2,400	44	800	4,000	400	12	45	400	16	1.3	1.2	1.6	3.0	1,200	1,200	115	18	300	15
	15–18	54	119	162	65	2,100	48	800	4,000	400	12	45	400	14	1.4	1.1	2.0	3.0	1,200	1,200	115	18	300	15
	19–22	58	128	162	65	2,100	46	800	4,000	400	12	45	400	14	1.4	1.1	2.0	3.0	800	800	100	18	300	15
	23–50	58	128	162	65	2,000	46	800	4,000		12	45	400	13	1.2	1.0	2.0	3.0	800	800	100	18	300	15
	51+	58	128	162	65	1,800	46	800	4,000		12	45	400	12	1.1	1.0	2.0	3.0	800	800	80	10	300	15
Pregnant						+300	+30	1,000	5,000	400	15	60	800	+2	+0.3	+0.3	2.5	4.0	1,200	1,200	125	18+[g]	450	20
Lactating						+500	+20	1,200	6,000	400	15	80	600	+4	+0.5	+0.3	2.5	4.0	1,200	1,200	150	18	450	25

Note: The allowances are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based a variety of common foods in order to provide other nutrients for which human requirements have been less well defined.

[a] Kilojoules (kJ) = 4.2 × kcal.

[b] Retinol equivalents.

[c] Assumed to be all as retinol in milk during the first six months of life. All subsequent intakes are assumed to be half as retinol and half as β-carotene when calculated from international units. As retinol equivalents, three-fourths are as retinol and one fourth as β-carotene.

[d] Total vitamin E activity, estimated to be 80% as α-tocopherol and 20% other tocopherols. See text for variation in allowances.

[e] The folacin allowances refer to dietary sources as determined by *Lactobacillus casei* assay. Pure forms of folacin may be effective in doses less than one-fourth of the recommended dietary allowance.

[f] Although allowances are expressed as niacin, it is recognized that on the average 1 mg of niacin is derived from each 60 mg of dietary tryptophan.

[g] This increased requirement cannot be met by ordinary diets; therefore, the use of supplemental iron is recommended.

Table 2. Dietary Goals for the United States, Select Senate Committee on Nutrition and Human Needs

Item	First Edition (Feb. 1977)	Second Edition (Dec. 1977)
Energy	Nothing	Control calorie intake
Carbohydrate	Increase to 55%–60% calories	Increase from 28% to 40% calories
Sugar	Reduce by 40% to 15% of calories	Reduce by 40% to 15% of calories
Fat	Reduce by 40% to 30% of calories	Reduce by 40% to 30% of calories
Saturated fat	Reduce from 16% to 10% of calories	Reduce from 16% to 10% of calories
Cholesterol	Limit to 300 mg/day	Limit to 300 mg/day
Salt	Limit to 3g/day	Limit to 5g/day

after the smoke has cleared, that our diet will not have changed much. We are creatures of habit and eating is a part of living that plays a considerably greater role than the ingestion of nutrients.

Finally, there are a number of controversial topics currently in the public eye. Among these controversial topics are the following: diet fads, megavitamins, food additives (both purposeful—GRAS—and adventitious), the Delaney Clause, natural toxins, mercury, saccharin, caffeine, fiber, and sugar. There are strong differences of opinion among experts in some of these matters. It is an uncomfortable situation when the public is exposed to widely disparate points-of-view. For example, we do not have agreed-upon answers as to whether large doses of ascorbic acid are beneficial for preventing or treating colds and cancer. We cannot reach a concensus as to whether the use of vitamin pills is a helpful nutritional concept. Most agree that the average individual who is consuming a mixed diet of meat, milk, cereals, fruits, and vegetables does not need additional vitamins. But, if a person takes vitamin pills and feels better, even though the so-called "placebo effect" may be responsible, there seems to be no firm reason why he should not continue.

The most obvious nutritional difficulty in this country is obesity. This can be handled by careful control of calorie intake and by exercise. There is also available evidence that certain elements of our population may have low iron or vitamin A intakes but very little else in the way of deficiences. On the other hand, if nutritional inadequacies are playing an important role in heart disease (arguable) or cancer (arguable), we at least ought to learn as much as we can about these possibilities. Guideposts should be available.

In most of the rest of the world the most obvious nutritional difficulty is hunger, but that is an entirely different story.

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Human Nutrition and Health

Philip L. White

> For most of the two hundred years of our history, the policy has been to encourage efficient food production, processing and merchandising. Economists have had little difficulty designing the means of achieving this objective. (Paarlberg, p. 108)
>
> . . . all strategies involve the necessity of education. (Stare, p. 54)

Human nutrition must be the leading goal for food and agricultural policies, insofar as nutrition relates to the nourishment of man. No one could argue successfully to the contrary. The National Nutrition Consortium proposed that a nutrition policy should "assure an adequate wholesome food supply at reasonable cost to meet the needs of all segments of the population, this supply being available at a level consistent with the affordable lifestyle of the era" (p. 57).

The AMA Council on Foods and Nutrition has enunciated some general policies for the improvement of the nutritive quality of foods, a necessary corollary to the above-stated policy:

> The maintenance of a high level of nutritional health requires the continuous availability of a wholesome, nourishing food supply that can provide all of the essential nutrients in amounts sufficient to meet human needs. If the nutritional quality of foods is insufficient to meet these needs, means are available to enhance this quality by addition of specific nutrients. (p. 1116)

The Council proposed general principles for the enrichment, restoration, and fortification of foods in order to assure a nourishing food supply and to accomplish specific nutritional objectives for the population. The enrichment of flour, breads, and other grains is one example. Allowance was made by the Council for foods intended for therapeutic or modified diets in which the nutrient content is deliberately modified qualitatively or quantitatively.

The primary question before this symposium is not so much, should food and agricultural policies assure an adequate, nourishing, and wholesome food supply, but rather, should policy take into account known or suspected food-related human diseases other than the classical nutrient deficiency diseases? Are there direct relationships between diet and coronary artery disease, atherosclerosis, cancer, diabetes, hypertension, etc. that should be taken into account when formulating policy? Are policy proposals such as *Dietary Goals for the United States* (U.S. Congress) practical and necessary at this time?

A positive response to that question will be permissible only when there is unequivocal evidence that a direct relationship exists between a food or food component and a given life-threatening or debilitating disease. In the absence of convincing evidence and while research proceeds, a national health policy should assure that citizens are kept sufficiently informed of the progress and results of research so that personal judgment can be exercised. This illustrates the difference between health policies and agricultural policies, and we would emphasize the desirability of coordinating the two as far as is practicable. The objectives of policy must be mutually compatible (Paarlberg).

The American Medical Association and several other organizations and individuals have taken the position that direct relationships between the degenerative diseases and dietary components are not sufficiently established or clearly defined to be used as a basis for the formulation of food and agricultural policies (AMA, CAST).

A rather theoretical classification of nutritionally-related diseases or disorders might serve to illustrate the difficulty of formulating policy when that policy would be based upon incomplete knowledge or be supported by assumptions. The classification might go as follows: (*a*) diseases known to be caused by diet, (*b*) diseases suspected (with reasonable confidence) of being related to diet, (*c*) diseases suspected (with limited confidence) of being related to diet, and (*d*) diseases that require dietary modification for their management. The advantage of such a classification is

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obvious. However, considerable personal opinion is required to classify the diseases, that judgment being influenced by the difficulty in assessing the practical significance of epidemiological data, animal experimentation, objective and subjective clinical research, and population intervention studies. The exercise is further hampered by the necessity to isolate the role of diet when it may be only one of many agents in a disease of multiple etiology. This obviously has to be done in order to determine whether induced changes in dietary practices dictated by national policy can be expected to bring about a desired change in the probability of morbidity associated with any given disease.

A more classical system of classification lends itself logically to considerations regarding policy, regulation, and education. The diseases or disorders with a nutritional component can be subdivided as (*a*) primary nutritional diseases, (*b*) secondary nutritional diseases, and (*c*) conditioned nutritional diseases.

The first, primary nutritional diseases, result from an inadequate or excessive intake of nutrients or calories in relation to normal body requirements. This condition may be caused by faulty selection of foods, by lack of money to purchase adequate food, or by actual food shortages. Examples of primary nutritional diseases include: (*a*) the classical vitamin deficiencies: scurvy, pellagra, beriberi, rickets, osteomalacia, xerophthalmia, and keratomalacia; (*b*) the mineral and trace mineral deficiencies, certain anemias, goiter, and dwarfism (from zinc deficiency); (*c*) protein-calorie malnutrition, starvation, and obesity.

Secondary nutritional diseases result from factors that interfere with ingestion, absorption, or utilization of essential nutrients or from stress factors that increase their requirement, destruction, or excretion. Two common examples are malnutrition resulting from chronic diarrhea and intestinal malabsorption syndromes and anemia in children associated with heavy infestation with intestinal parasites.

Conditioned nutritional diseases are the other diseases in which nutrition plays some secondary or associated role that so far has not been shown to be clearly related to the deficiency or excess of essential nutrients. Included are the diseases of multiple etiology with several environmental components exemplified by coronary heart disease (CHD). The environmental components of CHD may include diet, cigarette smoking, emotional stress, diabetes, lack of exercise, and high blood pressure. Also included among the conditioned nutritional diseases are those with a genetic or inherent component in their etiology such as phenylketonuria, galactosemia, and lactase insufficiency. Diseases such as diabetes, hypertension, and gout, that may have diet as one of several etiological factors and which necessitate therapeutic dietary management, are considered under the class of conditioned nutritional diseases.

Just where diet and cancer relate (if indeed they do) is unknown although some epidemiological studies and animal experiments suggest that there may be some relationships. The evidence is still too nebulous and the data too tenuous to permit us to develop any cause and effect relationships between diet and cancer (Enig, Munn, Keeney).

With this nutrition-disease classification in mind, we are better prepared to discuss public policy relating human nutrition and health.

Primary nutritional diseases can be prevented and in most cases cured by the institution of an adequate diet or specific therapy. Intervention may take the form of food enrichment and fortification, nutrition education, economic support by the provision of food—a leading goal for agricultural policy. Secondary nutritional diseases can best be dealt with on an individual basis by way of alleviating the precipitating factors causing the disease or by overriding the metabolic problem with specific and appropriate dietary intervention. The conditioned nutritional diseases are the most troublesome to deal with on a public health basis because there is no known dietary regimen or preferential life style that can assure control of these diseases. Diet may be very important for some individuals, yet unimportant for others in the control of disease. Where do we presently stand with diet and heart disease? Should we control intake of total fat or just saturated fats? Should we control cholesterol and increase polyunsaturated fats? Should we promote modified vegetarian diets? What about total calories, salt, fiber, protein, vitamin D, and every other dietary component that has ever been implicated one way or another in coronary artery disease? These are some of the things that must be considered when formulating policy. Is there a dietary regimen that has been tested sufficiently so as to become the basis for national policy? No, none has been so tested. Other means of reducing the incidence of the degenerative diseases must be sought, although the Senate Select Committee obviously felt that it is now feasible to formulate standardized national dietary policies to achieve that goal.

Our knowledge of relationships between diet and the development or aggravation of the degenerative diseases and of cancer is incomplete. There is not sufficient knowledge to permit the incorporation of mechanisms to control these diseases into national policies for food and agriculture. For the present, food, nutrition, and health education designed to assist our citizens to achieve and maintain optimal health is the best approach available. In this regard, the subtle differences between a food and agricultural policy and a national nutrition or health policy must not be overlooked (Quelch).

Health and nutrition problems are not caused by the food supply per se, but by the way it is used and abused. To induce changes in the composition or availability of foods that people eat regularly is an attempt to protect people from their own idiosyncrasies and ignorances. It finally comes down to styles of life that must be evaluated, not the food supply itself. Both may need to be reviewed, but the primary need is to equip people to evaluate their own commitment to health, vitality, and productivity. Obesity is directly and indirectly related to the incidence and severity of many degenerative diseases. This major public health problem can be solved when people become dedicated to more healthful styles of life. Food and agricultural policies per se cannot influence the incidence of obesity.

Efforts to restrict the availability of calories, fat, sugar, and salt by changing the composition of foods and restricting foods that do not conform to some ideal or preferred nutrient density in relation to its caloric content are unlikely to have the desired effects. Consumers would have to be properly educated to take advantage of the changes and we should be prepared to present convincing data to them that these changes will result in improved health status. Certainly, if consumers understood food combinations for nutritious meals, serving sizes, and the number of servings to meet nutrient requirements and caloric needs, there would be no need even to consider altering our food supply. Certainly it is clear that secondary and conditioned nutritional diseases are best handled on an individual basis and that there is no general confidence in the probability of reducing the morbidity and mortality of these diseases by the institution of specialized diets intended for the general population.

Policy always limits options and a complex chain of events follows any properly instituted policy. The events in the case of foods may include curbs on the production of certain foods, regulations on the composition of foods, inhibitions on the promotion and marketing of foods that may be considered undesirable, restrictions placed on foods permitted in institutionalized feeding programs—all events that restrict individual liberties and freedom of choice. Should the time come when certain new policies would be in the best interests of the citizens of North America, we must remember to provide for options or alternatives. Inhibitions should not be imposed on the marketplace that would invalidate those options.

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Nutrition Policies, Programs, and Politics

Sol Chafkin

Attention to nutrition is becoming something of a modest growth industry throughout the world. The clearest signs are bureaucratic jockeying within governments as to which department or ministry will be the lead "agency"; the formation of nutrition task forces, planning groups, committees, and other national and international institutional arrangements; the intense interest displayed by consumer groups in such issues as infant formula promotion, world hunger, and the effects of food additives; and perhaps most important are political decisions to appropriate funds for nutrition programs ranging from food distribution to nutrition education. Nutrition is now sufficiently popular so that there is strong bipartisan pressure in the U.S. Congress to increase the amount of money spent for research on the role of diet in prevention and treatment of cancer. The food industry, sensing something in the wind, is heavily advertising the nutritional merits of its products and developing new nutritional products.

The nutritional wave has grown to such an extent that Secretary of Agriculture Bergland stated the following a few months ago:

> To put it simply and plainly, we do intend to build and administer a total national food policy from the farmer to the consumer. We do intend to give the leadership and direction to correct the pervasive problem of malnutrition at its root sources—and that includes, to the extent possible, helping to meet the nutrition needs of people throughout the world.

Up to a certain point, the "politics of nutrition," is painless. Who can be against proper diets, especially for pregnant and nursing mothers and infants and children? But this politics is painless only up to a point. Some hint of future pain in the politics of nutrition is given in Secretary Bergland's speech when he notes that some in the food industry "believe they may be adversely affected by a nutrition-based food policy."

> Then there is the worry among many farmers and the food industry that the USDA will let nutrition and consumer concerns overshadow the demands and needs of producers, processors and distributors of food.

Governments generally tend to consider agricultural and food policies with little regard for nutrition considerations. Agriculture and food policies affect important political constituencies, whose economic status are affected by such policies. Thus, the prospect of formulating national food policy on the basis of nutrition objectives injects a threatening uncertainty into the policy formulation process.

As more governments get into more nutrition activities, be it for reasons of distributive justice, political necessity, or straight health improvement, the policy and political conflicts will emerge more sharply. The World Food and Nutrition Study, published in 1977 by the U.S. National Academy of Sciences, recommended among other things increased support for research on the nutritional implications of food supply policies and practices, food distribution and marketing policies and practices, and general government policies and procedures. Such research could provide a basis for planners to determine the extent to which existing and proposed policies exercise significant positive or negative effects on the nutritional status of the population as a whole or specific subgroups thereof. This category of research examines such subjects as national agricultural production strategies, food pricing and subsidy policies, food export policies, and a host of related agricultural sector-planning issues. Equally important is the recommended research on the nutritional implications of national development strategies and processes, income redistribution policies, and national budget and policy formulation processes.

These subjects, indeed, are at the very heart of the question of integrating nutrition into national planning and therefore into national

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political decision making. Does elimination of under-nutrition and malnutrition in poor countries depend on changing political and economic institutions? Can important nutritional goals be achieved and sustained by policies and policy changes that are feasible within existing political institutions? In at least one country—China—there is reported to be no policy or program specifically identified as "nutrition," and yet the system of governance reportedly assures adequate food for all. In another country—Sri Lanka—a universally available subsidized price for rice reportedly has produced measurable health benefits. A policy adopted for political purposes rather than nutritional ones apparently yields consequential nutritional benefits.

The nutrition research recommendations in the National Academy of Science (NAS) study recognize potential policy conflicts arising from a decision to integrate nutrition into national planning. A food subsidy policy may entail costs of a magnitude that would conflict with fiscal and monetary policies. A new land use policy to encourage increased production of traditional foods for domestic consumption may present problems for existing cash crop export policies. Incentive prices to farmers to maximize food production may clash with policies to bring consumer prices down for key foods.

It is evident that decisions on development objectives, strategies, and supporting policies can exercise a far more fundamental and powerful effect on incomes and consumption than the usual array of "nutrition programs." It is precisely for this reason that governments should be encouraged to undertake the effort of integrating nutrition into national and local planning and the kinds of research and analysis set forth in the NAS study. At the same time, it is important to recognize the very real limitations that will affect the utilization of such research.

Retrofitting nutrition into economic policies inevitably involves a reexamination of a large number of complex economic, social, and political factors. It is this complexity that explains in large part why countries are more likely to go the route of nutrition "programs" rather than seeking changes in basic macroeconomic policies. (It also partly explains the growing interest in community level nutrition programs in which local organizations mobilize local food and financial resources to meet local needs.)

Considerable attention is being given to the merits of achieving nutritional objectives indirectly by policy manipulation as compared with direct programmatic actions aimed at specific target groups. Unlike the program approaches, which are administratively cumbersome, policy approaches are "cleaner" and require no "heavy lifting." Pricing policies, exchange rate adjustments, tax policies, and so on can be operated through existing bureaucracies and do not involve messy problems of food handling, hiring program staff, and so on.

Nevertheless, changing a significant economic policy usually has consequences that require adjustment in a number of other important policies. This interdependence may in fact entail adjusting several policies all at the same time. Governments usually have difficulty in turning several policy levers simultaneously. Political leaders worry about the unexpected effects of policy changes, no matter how carefully the professional analysts have traced through all of the interactions on paper. Politicians do not want surprises and they do not want to be trapped in policy changes that do not provide an escape hatch.

Even if research suggests that a subsidy to producers of a staple food is the least-cost route to helping the poor, there persists the fear of trouble when it turns out that the subsidy helps the rich without helping the poor get fed. Policy mistakes of this kind can produce unpleasant riots, headlines, and turnovers in governments. An income supplementation policy to help low income groups is hard to turn off even when that policy turns out to be aggravating the problem of inflation and/or international payments stringencies. Generalized policies aimed at improving nutrition within a country may rock too many other and more important boats. An approach of this kind makes it difficult to find out whether those who need to consume more food are actually consuming more and whether consuming more is generating benefits significant for the society.

So it is not surprising if governments choose the program approach, e.g., targeted feeding programs. One can see the recipients, and one can see the food and the ration shops. While there are substantial administrative costs and untidiness in the program approach and occasional scandals, one can start a small program and enlarge it, if funds are available. If funds are not available for a large program, the government can run a small program and still show that it is doing something. Political leaders often prefer the certainties of giving something away to the uncertainties and dangers of large policy changes, which may work in a way that makes it hard for politicians to know beforehand who gains and who loses.

The program approach makes it possible to fit programs to virtually any level of available financing—selecting among rural or urban settings, women or children, children under age two versus older children, 20% of nutrient requirements versus 80%, using the smaller health-care delivery systems versus the larger school system, and so on. "Programs" also permit the leaders to employ people, shake hands, encourage community participation and volunteers, collect data on children's growth rates, and so on.

Many countries are already actively operating food and nutrition programs. As they consider more ambitious programs, we may expect countries to examine the possibility of incremental expansion or improvement of existing interventions. This will entail much more careful assessment of existing intervention programs, seeking increased efficiency and exploring the feasibility of expanded, improved, or new programs that can be financed by judicious redeployment of the existing quantum of available financial, food, and manpower resources. To the extent that policy research identifies politically and financially feasible policy changes, such changes may free budgetary resources for programs to reach groups not beneficially affected by the policy changes.

Some governments facing severe problems of financing the costs of nutrition intervention programs or policies may choose to limit costs by concentrating on eliminating specific deficiency diseases such as vitamin A blindness, iron deficiency anemia, and goiter, for which technology is available and delivery systems exist. Other governments may wish to limit costs by concentrating on specific age groups or specific geographic areas or both. Most governments will want to reexamine financing techniques for whatever programs and policies they select. This reexamination may include the possibilities of community-level programs and community self-financing thereof as well as the possibilities of financing such policies as a subsidy on a key food by tax on foods or beverages with zero or negative nutritional value.

Recognizing the constraints on the extent to which nutrition objectives can be realistically integrated in the near term into national policies, we should not be disappointed with countries that choose in effect a two-track effort—on the one hand exploring adjustments in economic plans and policies, and concurrently continuing to rely on programs aimed either at specific target groups or at specific geographic locations within a country. If this process works well, one can foresee evolving over time incremental adjustments in national and local planning to emphasize nutritional improvements and modification of intervention programs to reach those populations that either have not been reached before or that are not reachable by achievable changes in development strategies and policies.

It is interesting in this context to note that thus far the United States Government (like other governments) has found it easier to initiate and enlarge "nutrition" programs such as food supplementation programs than to modify basic policies. It has taken one important policy step in modifying specifications for federally-processed food, including adding fresh fruit to school lunch foods distributed by government and cutting down on sugar and salt in the canned products it provides.

Resistance to nutrition-oriented policy changes is enhanced by the uncertainties and unknowns in nutrition sciences. Thus, the famous dietary goals for the United States developed under the auspices of the McGovern Committee were attacked on the grounds that benefits were not proven or that segments of the food industry would be hurt. Squads of biochemists and nutritional scientists were wheeled into the controversy either offering contrary evidence or demanding scientific proof of the benefits of dietary goals. The scientific conflict will increasingly be reflected in political pressures on both sides.

Even if there were a complete scientific consensus that the dietary goals were in the right direction, how far could the government of the United States go in influencing or requiring adherence to those goals? The experience with cigarette smoking suggests that even when the proof of harm is overwhelming in the judgment of most scientists, it has been politically impossible to eliminate subsidies for the production of tobacco or ban the production and distribution of cigarettes. Such progress as has occurred has generally resulted from the pressure of citizen groups outside of government to ban smoking in supermarkets, elevators, portions of restaurants, portions of airplanes, trains, and so on.

Thus, one policy and political issue that emerges is whether a government can act through policy and legislative and regulatory mechanisms to influence food consumption patterns without incontrovertible "scientific proof" of whether it can make decisions on the basis that particular dietary changes might help and in any case will do no harm. In effect, the government might require proof from the opponents that the proposed changes will do harm and proof that continuation of existing diet patterns do no harm.

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Discussion: Can Human Nutrition be the Leading Goal for Food and Agricultural Policies?

R. M. A. Loyns

After some reflection one might be inclined to respond to this question with another question: What other possible main goal could there be? Dr. White posed the response very forcefully, and in the affirmative, "No one could argue successfully to the contrary." Arguments are available that imply this conclusion; a few of these will be reviewed. However, the more plausible response is implied in Dr. Chafkin's paper. It is his theme that this discussion is intended to reinforce.

The comments are limited to domestic considerations, i.e., Canada and the United States. There are two reasons for imposing this limitation. First, I do not feel competent to discuss off-shore production/distribution/nutrition problems. Second, Canada and the United States appear to be taking some initiatives in food policy, and public statements are being made about the positive and significant steps to be undertaken to improve overall nutritional status. Despite this limited scope, perhaps many of the arguments would also apply to other countries despite differences that exist in the nature and source of nutrition problems.

Food and Nutrition

As a lay observer, I would suggest that food serves four general functions for humans: (*a*) providing energy, a continuous but short-term requirement; (*b*) providing nutrition, fundamental to longer-term health and productivity; (*c*) meeting certain social objectives of people; and (*d*) providing prestige satisfaction for some.

Further, I would suggest that these functions are ordered according to their importance. This particular ordering is derived from the "needs hierarchy" that psychologists impute to human behavior. If we consider what the psychologists say about needs, we see that the functions served, in terms of needs, are very different. The first two functions (that is, the most important functions) are really serving the basic, biological needs, or as they are termed, the "biogenic needs." The second two functions are meeting "psychogenic needs." With such basic human needs being met, it should not be difficult to respond to the question "Nutrition in Food Policy?" in the affirmative.

Consider an economic argument. Marshallian economics says that the purpose of all economic activity is consumption. We are told by businessmen, politicians, bureaucrats, farmers, and by much of our own literature as well (with the notable exception of J. K. Galbraith) that today's society is dominated by "consumerism," that our priorities are all consumer-oriented, and generally that Marshall's proposition is true.

To further reinforce the affirmative, consider these figures. Sabry (p. 291) estimated that the cost of "hospitalization, medical-dental care and loss of productivity due to premature death and absenteeism . . . related to nutrition" was $7.8 billion in Canada in 1975. He also estimated that "improved nutrition" could reduce this figure by $2.5 billion. These are only rough estimates, and they are not full social costs. But the savings represent about $115 per Canadian, or about $250 per labor force member; these are substantial numbers. In contrast, combined federal and provincial expenditure on direct nutrition programs in 1975 was about $1 million.

What this evidence provides, however, is a rationale, or a subjectively defined need, for greater attention to matters involving nutrition. What these arguments, and their counterparts, miss is the political environment

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within which such policy decisions are made. Dr. Chafkin's paper outlines a number of issues related to the political process. The remainder of this note will do the same but from a somewhat different perspective.

The Political Process

Because of space limitations, only the bare outline of the arguments can be presented. In this context, the "political process" means the general political philosophy displayed within our economies, as well as existing political institutions and vehicles, and the general power structure framework. Specifically, two areas are discussed: (*a*) the political philosophy relating to micro producing units in private enterprise and the micro consuming unit, i.e., the household, and (*b*) some consequences of the balance of political-economic power in public decision making.

Political Philosophy

Few would disagree that, for the majority of domestic consumers, "adequate, nutritious" supplies of food are available at affordable (as opposed to reasonable) prices. There are probably some consumers for whom ignorance of nutritional requirements and sources produce significant nutritional deficiencies. And no doubt there are residents of remote communities, the aged, and the poor for whom the general statement on adequacy of food is hardly relevant. With these exceptions, however, for the majority of consumers nutrition problems are a matter of choice. It is, therefore, attitude and life style which is at the root of a very large component of the domestic nutrition problem.

Perhaps our prime minister summarized the political philosophy argument well when he said, "the state has no business in the bedrooms of the nation." He did not say it, but it is implicit, that many also believe that neither has the state any business in our kitchens and dining rooms.

Home management, eating habits, and personal life styles remain off-limits to government intervention. There are exceptions: tobacco, alcohol, red food coloring, DES, cyclamates, and so on, but these are all additives of sorts which are perceived or proven to have harmful effects. Natural foods taken in the wrong proportions have just as severe effects, perhaps worse, but they are accepted because we believe individuals should have that "free" choice.

Complicating this situation is the expense of penetrating life styles to achieve a perceptible result. Simple additives are easy—they can be banned. Effectiveness of the antismoking campaign has been elusive and expensive. Consequently, significant efforts to upgrade nutritional status among North Americans through alteration of life style have been limited.

Similarly, our political philosophy results in considerable reluctance to infringe on those proportions of the free enterprise environment that contributes to nonnutrition. Preprocessed, further processed, highly refined foods, and empty or junk foods represent innovation personified in an otherwise technologically quiet industry. Moreover, these products also have met with a high degree of consumer appeal. In a few cases, they have revolutionized or maintained portions of agriculture, for example, potato production. In both countries, we have a reluctance to tinker with a high degree of free enterprise success.

Political Power

The relevant considerations here can best be conveyed by Galbraith's arguments on consumer nonsovereignty (Galbraith 1970, 1973). Consumer sovereignty in the market is largely a myth, and real consumer clout in the political process is sporadic. It would be incorrect to conclude that the reason for the low priority on nutrition problems, nutritional upgrading, and education is the nonexistence of real problems or, indeed, a lack of documentation. It is my thesis that it results because the political pressures restraining a meaningful thrust toward solution of nutrition problems far exceeds the disjointed efforts to achieve progress. This situation is common to most "consumer" problems.

Nutrition is a complex subject. The experts do not even seem to agree what constitutes problems related to nutrition. Nor does there appear to be a great number of experts on the subject in either country. And, apparently, most of those who understand the problems, not already in the employ of food producers are, as Sabry (1975, p. 291) has said, "mainly in the employ of governments or universities. With the politicians controlling the government apparatus and with the universities relying almost solely on government funding, the initiative for action falls back on the politician's shoulders." Progress is slow; my perception is that the time is not now.

One Farm Policy Reference

For years, it has been accepted that one component of food and agriculture policy should be differential pricing between domestic and foreign markets—the two-price scheme. Usually the export market is more elastic in demand, consequently the domestic price is highest. The concept is institutionalized and examples are abundant: in Canada at present, it is used in bread wheat, winter wheat, white beans, dairy products, eggs, poultry meats, and a few hog sales. The list in the United States likely would be different in composition but similar in importance. Despite the negative economic implications, political forces perceive this to be an acceptable, perhaps "good," pricing policy for certain farm products.

But viewed in the consumer/public interest context and, in the context of nutrition in food policy, it raises some questions. For example, given that we have nutrition problems, and given the likelihood that differential pricing will continue, could we not segment the total market into components which might at least improve domestic nutrition problems? Could we partition the market into its (*a*) domestic commercial, (*b*) off-shore, and (*c*) domestic less-than-commercial components? Presumably demand elasticity in the latter market would be greater than that of the commercial market. Similarly in a product like milk, where the nutritional problem is a combination of dropping consumption and butterfat, why not raise the relative price of normal fat milk products? In these manners, a given policy for agriculture could be meshed with a policy for food and nutrition, rather than aggravating our problems as may now be the case. I doubt that this effort has been made in Canada, and I doubt that it was really the spirit of school lunch or food stamp programs in the United States. It is this kind of broader perspective that is needed on food policy, and an effort to harmonize policy instruments among competing goals.

Summary

My reluctant conclusion to the question "Can nutrition be a leading goal for food and agricultural policies?" is: Not at present! The reasons for this conclusion lie in the political/economic priority/vested interest-power interfaces. Despite the strong statements being made by prominent politicians and some of the optimistic comments in the papers, the countervailing forces remain dominant. The operational goals for farm and food policy will remain heavily farm, and output, oriented.

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Small Farms: Effective Contributors to Economic Development
(Warren H. Vincent, Michigan State University, Chairperson)

Farming Systems Research To Improve the Livelihood of Small Farmers

D. W. Norman

We in the high income countries have exhibited strong biases, sometimes unknowingly, in our dealings with the less developed countries (LDCs). That has certainly been true with respect to agriculture. Over the last two or three decades our thinking has evolved through four successive stages: (*a*) believing the extractive philosophy of colonial times; (*b*) knowing what was best for the LDCs, resulting in transfer of technology from the high income countries; (*c*) developing technology within the LDCs, using as building blocks elements that had made technological change successful in the high income countries; and, recently, (*d*) supplementing this "top-down" approach, but not replacing it, by a "bottom-up" approach, which provides a foundation for the so-called farming systems approach.

Among reasons for changes in thinking, the first was the repeated failure of strategies, particularly of the first two, to improve the livelihood of small farmers. Policies and technologies incompatible from both a technical and a human point of view were advocated. As a result, they were either not adopted or were adopted under direct or indirect compulsion, sometimes to the long-term detriment of the small farmer, as happened, for example, with export-cash crop emphasis in Africa. The second reason is that where improvements in the well-being of small farmers have taken place, it has sometimes not been as great as expected, while there has been inequity in terms of the distribution of benefits. In the case of rice, determining reasons for the former has been a focal point of the contraints study at International Rice Research Institute (IRRI). Although the success of the Green Revolution should not be underestimated, the "top-down" approach, together with the primary emphasis on production, tended to ignore the potential distributional problems (Saint and Coward). Despite claims that technologies implicit in the Green Revolution were intrinsically neutral to scale, the quality of resources required, together with differential access to the requisite infrastructural support systems, resulted in inequalities in benefits to farmers. That is at odds with the renewed interest in rural development, for which a basic prerequisite is the presence of an income-generating force for the majority of farmers. In most areas that force will have to come from agriculture and is consistent with generating employment, so significant in the new economics of growth. A third reason for the evolution of thinking about agriculture in LDCs has been the rising costs of fossil energy, firmly embedded in so much of the technology developed in the LDCs (e.g., Green Revolution technology), together with an increasing realization, supported by empirical evidence, of the value of many traditional practices undertaken by small farmers for generations (Jodha, Navarro, and Norman). It has been argued that the major breakthroughs in technology exemplified in the Green Revolution now may have been achieved. The gains from such technology were often regarded as sufficient to more than compensate for the potential social costs involved in its adoption (Remeniyi). With the increasing likelihood that further quantum jumps might not occur, the equity issues will become more vocal and pressing. Other factors also have contributed to the emergence of a "bottom-up" approach to the development of technology. Popu-

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larized as the farming systems approach, it is not easy to define and is applied rather loosely.

In this paper, I shall attempt to define a farming system, to review briefly the common denominators in farming systems research as currently practiced, to give three examples illustrating the potential value of farming systems research, and finally to point out some problems in executing such research at the present time.

The Farming System

A farming system is the result of a complex interaction among a number of interdependent components. To achieve it, an individual farmer allocates certain quantities and qualities of the four factors of production—land, labor, capital, and management—to which he has access, to three processess—crop, livestock, and off-farm enterprises—in a manner which, within the knowledge he possesses, will maximize the attainment of the goal(s) he is striving for.

The types and physical potential of livestock and crop enterprises will be determined by the technical element (figure 1) that reflects what the potential farming system can be and, therefore, provides the necessary condition for its presence. Constituents of the technical element include physical and biological factors that have been modified to some extent by man, often through technology development.

The farming system that actually evolves, however, is a subset of what is potentially possible as defined by the technical element. The determinant that provides the sufficient condition for the presence of a particular system is the human element, characterized by two types of factors: exogenous and endogenous. Exogenous factors (i.e., the social environment), largely outside the control of the individual farmer, will influence what he will and or is able to do. They can be divided into three broad groups: community structures, norms, and beliefs; external institutions or those that are usually supported directly or indirectly by developmental agencies such as extension, credit, input distribution, and product-marketing programs; and miscellaneous influences, such as population density and location. The endogenous factors, on the other hand, are controlled by the individual farmer, who ultimately decides on the farming system that will emerge, influenced and sometimes constrained by the technical element and exogenous factors.

Because of the complexity of the farming system, often technology thought to be rele-

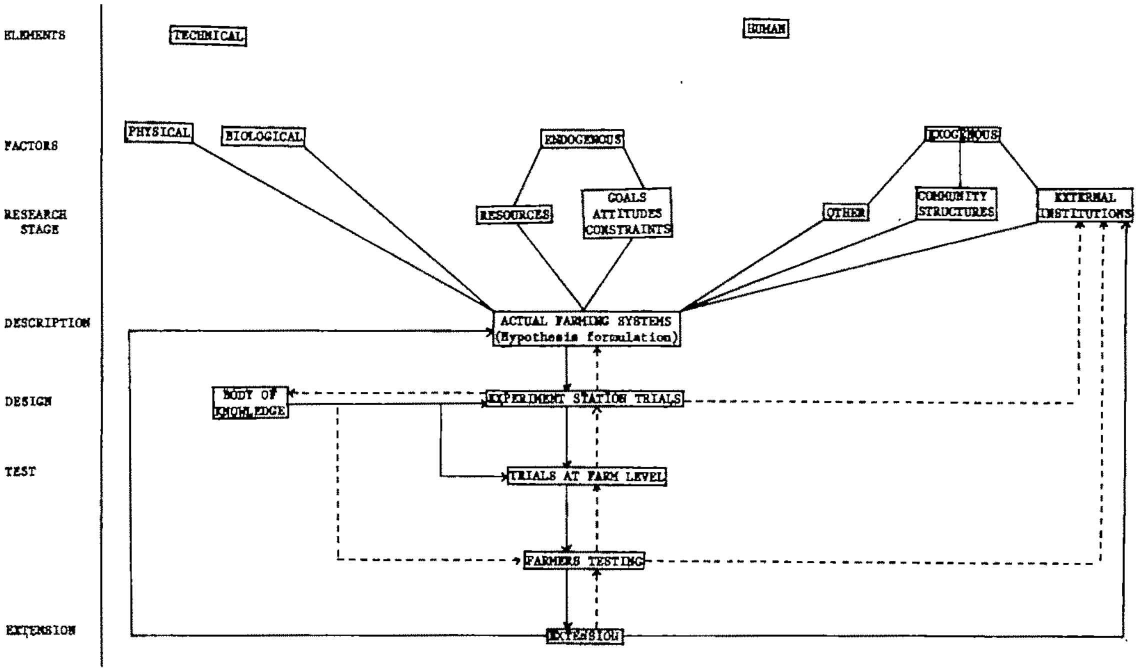

Figure 1. Schematic framework for farming systems research
Source: Slightly modified version of IER.

vant has not been adopted, or where it has been, it exhibits variations in degrees and levels of adoption. For example, much technological development has had a "top-down" approach of modifying the technical element to fit the crop or animal, while the human element has been ignored. The farming systems approach, on the other hand, potentially imparts greater reality to technology development by making it a variable (Saint and Coward) instead of a parameter as in the "top-down" approach. As such, it increases the potential for fitting the animal or crop to the environment rather than vice-versa (Van Schilfgaarde).

Farming-Systems Research

Research on farming systems in the LDCs has developed mainly within the last decade and is now represented in Africa, Asia, and Latin America. Work is being undertaken at national (e.g., ISRA in Senegal, ICTA in Guatamala, etc.), regional (e.g., CATIE in Costa Rica, GERDAT located in France but providing an umbrella for work in Francophone countries in Africa, etc.), and international (e.g., IRRI, ICRISAT, ICARDA, IITA, CIMMYT, ARVDC, etc.) institutes. Despite differences in degrees of emphasis at the various institutions, a conventional wisdom is slowly emerging regarding the execution of farming systems research, so that common denominators concerning such work can be identified. The schematic framework in figure 1 (IER) provides a simplistic approximation of the approach being used in some institutions. The common denominators can be summarized briefly as follows.

To develop truly relevant improved technology, it is necessary to recognize the interaction of the technical and human elements. That can best be ensured by the "bottom-up" approach characteristic of farming systems research. This requires a multidisciplinary group working in an interdisciplinary manner, with the social scientist playing an *ex ante* rather than simply the traditional *ex post* role characteristic of the "top-down" approach.

There is recognition of the locational specificity or heterogenity in terms of the technical, exogenous, and endogenous factors. Recognized in the farming systems research approach is the necessity of disaggregating such heterogenity into homogeneous subgroups and developing improved technologies appropriate to each. The disaggregation into homogeneous subgroups is first done in terms of ecological systems or according to differences in the technical element; then, if further disaggregation is necessary, in terms of differences in the human element. The constraint(s) most limiting in the farming system, as revealed by analyzing the results, then become a focal point for developing strategies that will overcome them or that at least will not exacerbate them further. The strategies envisaged need to be compatible with the exogenous factors. Developing strategies to overcome the most limiting factor (Binswanger and Ryan), incidentally, may not always involve the development of technology, but rather group action; for example, in irrigation.

The farmer is a central figure in the research process. Explicitly recognized is the value that a farmer's knowledge, based on his experience (Swift) and traditional experimentation (Johnson), can play in improving the farming system he is following. At the same time, his involvement increases the possiblity of developing improved systems that will address the constraints he faces and, in building on the good parts of the system he already follows, will result in a new response surface which is a combination of the new and old (Harwood and Price). Thus, many changes envisioned in farming systems research involve small adjustments in the system rather than complete changes. The role of the farmer is maximized and reality in the research process ensured by minimizing work on experiment station fields and maximizing it on farmers' fields; initially, the managerial input is provided by the research worker—trials at the farmer's level (fig. 1); and then, often later, by the farmer himself—farmer's testing.

Explicit in the recognition of a farming system is an appreciation of the multiutilization of resources, and the involvement of the farmer ensures the use of evaluation criteria relevant to the farmer, rather than simply the traditional net return per unit of land so often used in experimentation.

The research process is recognized as being dynamic and iterative, with backward linkages between farmer and research worker, rather than simply the presence of forward linkages characteristic of the "top-down" approach.

The farming systems research approach is not intended to replace other basic and applied research (i.e., body of knowledge, as noted in fig. 1) but uses results from it whenever possible, by providing an integrative function, and sometimes assists in giving priorities for research.

Value of Farming Systems Research

Collinson cites work reported by Kiray and Hendricks in Turkey concerning the introduction of high-yielding deltapine varieties of cotton which were incompatible with the endogenous factors of some farmers. Substituting deltapine seed for local varieties affected the structure of the agricultural community adversely. Many of the small farmers could not earn sufficient income from the new varieties; as a result, they were forced to work part time for the larger farmers and, in fact, later some became landless as the larger farmers bought up the land. Raising deltapine was incompatible with the economic circumstances of the small farmers because, unlike the local varieties, it matured in so short a time that small farmers having to rely on family labor could not complete the harvesting operation. Large farmers, on the other hand, could cope because they could afford to hire labor. With a farming systems approach, the farming structure might not have been so altered.

Another example pertains to cotton growing in northern Nigeria (Norman, Hayward, Hallam), where cotton, often grown in crop mixtures, traditionally is planted late, after priority has been given to food crops and the peak labor demand is partially past. Growing cotton according to recommended practices involved planting earlier in sole stands, required the application of fertilizer, and also required spraying six times with a knapsack sprayer that used twenty gallons of water per spray per acre. Although in per acre terms the net return was demonstrated to be 110% more than that from growing cotton in sole stands by using traditional practices, no farmers accepted the recommendations. The reasons were obvious when articulated in terms of the farming system, and demonstrated, once again, incompatibility with the endogenous factors. The change in the labor distribution involving an increasing conflict with food crops meant that the improved cotton technology was no longer being compared with the traditional cotton technology but instead with the alternative of using the labor on food crops. That plus the problem of transporting large amounts of water for spraying precluded adoption. Using a farming systems approach led to supporting the development of a technology under which cotton could be planted later and, although yields would be potentially lower, would fit in better with the farming system practiced in the area. Also recommended was replacing a water-based insecticide with an oil-based insecticide that could be applied with an ultra-low volume sprayer.

An example in eastern Guatamala (Hildebrand) illustrates a genuine farming systems approach from the outset. A survey indicated that the two controllable factors most important in limiting production of the traditional farmers on the steep hillsides were the limited planting season and the amount of bean seed the farmer had left to plant. Traditionally corn, beans, and sorghum are planted together at the same time in a number of similar arrays. Research indicated that by using twin or double rows of corn and sorghum, combined with reducing the population of beans (which require the most time to plant), it would be possible to raise the productivity of planting labor and of bean seed. That would be so because it would allow each farmer to plant more land than he could under the traditional cropping system, and land was not a limiting factor for most farmers in the area. Results of tests with farmers indicated that each farmer on average could, with the same amount of labor for planting and somewhat less bean seed, plant 40% more land, produce 75% more corn, 40% more sorghum, the same quantity of beans; and receive 33% more income. At the same time, labor could be more fully employed on the farm at other times of the year.

The examples should indicate the perils of not using a farming systems approach to assess the value of a proposed technology, the potential advantages in using such an approach to increase the efficiency of the resources devoted to developing improved technology, and the potential gains in terms of improving the livelihood of small farmers.

Problems

So far in this paper, I have strongly supported the concept of a farming systems research approach. At the same time, however, it is necessary to recognize problems with its potential execution and widespread adoption. Some of these are as follows.

The term farming systems research is somewhat a misnomer. To date most research has been confined to crop production processes. Even here methodologies for undertaking such work need to be improved. Apart from pleas for its desirability (De Boer and Welsch), the approach rarely has been applied to livestock processes, unless it impinges directly on crop processes. Other areas generally omitted from consideration to date are more explicit consideration of off-farm enterprises and a more holistic systems approach, which goes beyond the farm gate and attempts to endogenize, for example, the marketing process.

In the approach, a possible conflict exists between short-run private gains and long-run social costs. Articulating constraints by farmers may tend to be biased toward the former, which could exacerbate the latter (e.g., perhaps by a lack of concern for maintaining or even improving soil fertility where individuals simply have usufructuary rights to land). The potential conflict needs to be recognized by those using the research process so that they can apply evaluation criteria that appeal to the farmer but do not lead to such a conflict. The onus lies on developing technology that does not encourage such a situation. Such a responsibility has, for example, been recognized in the work of ISRA (Elliott).

There is inevitably a time lag in the recognition of a problem, the finding of a relevant solution, and its adoption by farmers. Farming systems research can be time-consuming, particularly when potential solutions are not available as a result of other research (i.e., the body of knowledge noted in fig. 1). There is then a conflict between shortening the time period for deriving solutions in farming systems research by drawing on the body of knowledge and recognizing that considerable inefficiency, in terms of time and research resources, may have been involved in creating that body of knowledge in the first place. A farming systems approach is now, quite rightly in my opinion, being advocated in places where the body of knowledge is not well established. Funding agencies, however, need to recognize the implications of the time required to derive results. Also, such results when achieved may not be visually spectacular although in aggregate may be large. With reference to the time between the derivation of solutions and their adoption by farmers—adoption being the best test of their relevancy (Hildebrand)—the link with extension and development agencies is often not as well established as it should be. That alone provides sufficient reason for involving representatives of such agencies in the research process (IER).

Because of the locational specificity of farming systems research, it is intrinsically expensive to execute. We need to explore ways to maximize the return from such research by making results more widely applicable. Technological development can aid this through the incorporation of greater flexibility in application even though that may mean some sacrifice of potential maximum return.

Farming systems research tends to be approached from the perspective of a high income country and often is undertaken by individuals originating from, or at least trained in, such a country. As a result, it is difficult for those persons to appreciate and understand local wisdom and values, to handle the complexities of a family-farm system, to appreciate the role of noneconomic variables and the potentially significant role to be played by rural sociology or anthropology, and to be able to fit into an interdisciplinary farming systems research team. Currently such an appreciation is being gained by individuals with longevity in the field, helped sometimes by short courses at regional and international institutions rather than through academic qualifications obtained in high income countries. This deficiency needs to be rectified.

Conclusions

The farming systems research approach is consistent with current notions of rural and economic development as articulated in equitability, local participation, and employment generation. As yet, however, perhaps mainly because it is largely in the developmental stage, the farming systems research process has not been firmly established as an efficient way to improve the livelihood of the majority of small farmers.

I believe that the future in the LDCs is now more promising than previously, in that we in the high income countries are at least shedding some of our cultural arrogance. To paraphrase the words of a wise Islamic scholar, Alhaji Junaidu, sound development must build upon rather than destroy the farmers' traditional techniques. I think now, toward the end of the fossil energy era, we in agriculture are at last beginning to appreciate the desirability and indeed the necessity of such an approach, which lies at the base of the farming systems research process.

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Farming Systems Research to Improve the Livelihood of Small Farmers: Discussion

Delane E. Welsch

Dave Norman presents an interesting point of view on what farming systems research is, what it can do, and what it cannot do. I like the way he starts the paper, by pointing out that farming systems research has developed in an evolutionary way, rather than as a radical departure from the previous thinking about research on agriculture in developing countries. The author divides the previous thinking about, or philosophy towards, inducing technical change in agriculture in LDCs into four stages which could be called (*a*) the colonial extraction stage; (*b*) the Corn Belt-county agent stage (if it works in the Corn Belt, it will work in Nigeria if properly extended); and (*c*) the within-country (LDC) but still high income-country-type research (fossil fuel, commodity based). The fourth stage is the farming systems stage, which is characterized as being "farmer-based," whereas the previous stages were "top-down." The author implies that we are more firmly into stage four than I feel we are. I think that researchers, research administrators, and others who control research funding in the LDCs are still predominantly in the third stage in their thinking and their attitudes on research. Only a small minority, but thankfully a vocal minority, are firmly into the farming systems stage.

Granted, one cannot fully elaborate the farming systems research model in only eleven pages; yet, the next section starts off with what seems to me to be a serious omission. The author defines a "farming system" as "the result of a complex interaction among a number of interdependent components." But he neglects to include the household as one of those components. Consumption by the household, as well as its time allocation decisions, is a necessary and integral part of farming systems for small farms in LDCs. The household producing-consuming model is becoming more widely known through such studies as the Singapore Household Studies Workshop (De Tray) sponsored by A/D/C. Research papers on LDC problems involving the household model are also beginning to be seen in this *Journal* (Benito, Evenson). Another example is Hayami.

Omitting the household led the author to include only three "processes" in the system he defined; namely crop, livestock, and off-farm enterprises. The model should also include production of household goods and leisure.

The author lists four "factors of production" allocated to those processes. Land and capital (including credit, I presume) are conventional factors, and I have no objection to their inclusion. However, I object to the inclusion of "management" as a factor of production. The author's fourth factor, labor, might more usefully be merged into a more complete factor, "time," because the allocation of time of the family is the core of the household model. The choices then become how much time to allocate to household production, to farm production, to off-farm activity, and to leisure. Toquero has shown the important effect on marketable surplus that price-induced changes in time allocation can have.

The strongest part of the paper is the discussion of the "common denominators" concerning farming systems research, accompanied by figure 1. The diagram is, as the author cautions us, overly simplistic, but it does convey the general concept. There are two parts of the diagram that need special comments. First, the relationships of experiment station research, research on farmers' fields, demonstration plots, and extension, and who is in control at each stage, are very complicated. This process is not new, but the farming systems approach gives a new meaning and purpose to such activities on farmers' fields. The biggest change is probably on the control of such activity, using the backward linkage of

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Suggestions by Dave Nygaard are appreciated.

feedback from the farmers upon whom the approach is based.

How to design this set of steps and relationships and to forge the proper linkages are areas of farming systems research in which we have no relevant examples in the rich countries, and in which we all, with a few notable exceptions, still do very poorly. When properly designed, this approach hopefully will be less likely to lead to the development of "all-or-nothing" types of packages of technology, and more likely to lead to "pick and choose" packages.

The second part of the diagram that needs special attention is the classification of human factors into endogenous and exogenous. It should be pointed out that the factors which are exogenous to the farmer, however, are usually endogenous to the policy maker. Thus, an important part of a farming systems research effort is policy-related research on those variables exogenous to the farmer that constitute a constraint to his employment and income. I am not down-playing the importance of the factors exogenous to the farmer, because, as the second paper in this session, the Hart and Sisler paper, shows, such factors are exceedingly important.

The examples of the value of farming systems research are interesting and illuminating. The list of problems is also quite insightful, revealing the considerable experience of the author. All in all, it is a good paper, which could be even better if the household were brought into the model.

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Aspects of Rural Labor Market Operation: A Javanese Case Study

Gillian Hart and Daniel Sisler

There is a marked tendency to regard rural workers as an undifferentiated and homogeneous mass. In reality, the agricultural labor force in many parts of Asia is extremely diverse, composed of men, women, and children from both landowning and landless households. The central concern of this paper is the extent to which households in each of these asset classes are likely to benefit from an increase in labor demand and wage rates. On the basis of evidence from a densely-populated rice village in Central Java, we argue that an expansion in productive types of employment may have a differential impact on small-landowners and the landless, with the latter gaining less than the former.

The reasons for this derive from the way in which control over rice land influences both labor supply behavior and access to work opportunities in differentiated labor markets. As far as labor supply is concerned, both men and women from the small-landowning class are highly responsive to increases in wage rates. Conversely, the security afforded to small-landowning households of being able to produce a large proportion of their basic rice needs enables women to withdraw from the labor force in slack seasons when wage rates decline and working conditions deteriorate. In contrast, the landless have to purchase virtually all their rice, and confront substantial seasonal price fluctuations in food-grain markets. Survival depends on a close degree of coordination among the activities of household members, and on women and girls being willing to work long hours at extremely low wage rates in slack seasons. Given their need to ensure a constant flow of income into the household, the landless are less able than small-landowners to engage in more remunerative activities which are of a relatively short-term nature, particularly if this is likely to jeopardize more stable, low-wage employment. There are also strong indications that when favorable opportunities do arise, the nature of class and labor relations are such that small-landowning households are likely to have preferential access.

The basic thrust of this paper is that in order to assess the impact of an increase in labor demand, it is essential to gain a detailed, micro-level understanding of household allocational strategies and the operation of the system of class and labor relations. These considerations are reflected in the following two sections which describe and analyze the salient features of the structure and functioning of labor markets in the study village.

Labor Market Structure and Access to Work Opportunities

Rice cultivation is the predominant economic activity in the study village, which is located on the north coast of Central Java. The ratio of rice fields to total cultivable area (71%) and the number of people per hectare of rice fields (10.7) is virtually identical to the common ecological type defined as "area of rice fields large and population dense." The 200 hectares of rice land are, however, very unevenly distributed among the approximately 500 village households. In the sample of 86 households, stratified proportionately on the basis of landownership, 9% (those with more than one hectare) control nearly 60% of the rice fields, while landless and near-landless households (defined as those with less than 0.2 hectare) constitute 53.5% of the population and control only 5% of the rice fields. A large proportion of small to medium landowners have pawned their land to one of the small group of large landowners and are sharecropping it back. While frequently receiving only 30% of the yield and covering all costs of production,

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they obtain preferential access to wage labor opportunities within the village. In effect this represents a type of patron-client relationship within the landowning group from which the landless are largely excluded.

Central to the understanding of the system of access to work opportunities is the sharp distinction between the nature of labor relations within and outside the village. The former operate via a subtle and complex system of interhousehold obligations (Stoler) whereby people do not overtly seek work; rather they are "invited" to engage in wage labor, an invitation which often carries with it the expectation of reciprocity. For these and other reasons, small-landowning households tend to have preferential access relative to the landless. Jobs outside the village are considered inferior and demeaning for several reasons. In addition to workers receiving low wage rates for very arduous types of labor and frequently having to walk long distances, they must ask for work and enter into formal commercial contracts. In general, only members of landless households work outside the village.

These relationships are a central feature of the interaction between labor demand and supply. The labor demand profile is governed by patterns of seasonality in rice production. After having suffered severe losses due to pest attacks on high-yield varieties (HYV), most farmers were cultivating local varieties. Consequently, there was more or less simultaneous planting and marked seasonal variations in the demand for female and male labor. Irrigation allows for two rice crops a year, and the demand for rice labor is concentrated in six to seven months. With the exception of harvesting, there is a clear division of labor by sex in rice cultivation and some overlap in the slack periods of demand for female and male labor. The degree of seasonality in wage rates and employment is more marked for women who earn considerably lower wage rates than men. In the slack periods, women have the option of seeking wage labor outside the village, much of which is in sugar cane production. Male nonrice labor markets are more diverse, with wider wage differentials. Low wage rates for both men and women tend to be associated with long duration jobs, whereas high wage employment opportunities in the slack periods are more sporadic. They are limited to men, and depend on informal contacts within the village.

Data on labor supply behavior within this structure of opportunities were collected monthly over the course of a year, and reveal clear differences among large-landowning, small-landowning, and landless households (Hart). There is a strong inverse relationship between asset status and work duration—defined to include on-farm work and off-farm labor—which is particularly marked in the case of women. People in the largest landowning class are rarely involved in off-farm work. While the intensity of rice cultivation on small farms is comparatively high, farm size is so small that the absolute and relative amount of time spent in on-farm labor is limited. Men and women from small-landowning households spent 73% of their income-earning time in off-farm work, of which 67% was in wage labor. This provided 40% of annual household income. The small-landowning class is, therefore, in direct competition with the landless who are almost wholly dependent on wage labor. During peak periods of rice production men and women from both small-landowning and landless households are heavily involved in wage labor, and interclass wage differentials are minimal. In slack periods men with small landholdings earn wage rates between 25% and 30% higher than those who are landless. There is a strong tendency for women from the small-landowning class to withdraw from the labor force in slack periods, while landless women continue to work long hours at wage rates in the vicinity of 3¢ an hour, usually outside the village. This is approximately half the wage earned in the peak transplanting period.

A careful examination of the relationship between wage rates and hours worked reveals that labor markets operate with a substantial degree of sensitivity to seasonal variations in demand and work opportunities (Hart, chap. 5). The analysis also shows that the marginal value products of female and male labor in rice production are very close to wage rates (Hart, chap. 7). These findings suggest strongly that Lewis's and Geertz's notions of institutionally-determined wage rates and work spreading are incorrect. Does this evidence provide a sufficient basis for supposing that labor markets operate perfectly? We contend that the question of whether or not labor markets function along neoclassical lines must be defined from the viewpoint of the individual household. From this perspective, there are two critically important implications inherent in the perfect labor market assumption. First, the wage rate is independent of hours worked. Second, all people with given skills and physical capabilities have equal access to labor markets.

The Functioning of Markets for Female and Male Labor

The earnings functions reported in tables 1 and 2 provide an empirical basis for testing these hypotheses. The basic equation estimated separately for females and males in each month is

$$\ln Y_{ih} = A_i + \alpha_i \ln Hours_{ih} + \beta_i \ln Assets_h + \gamma_i (C/N)_{ih} + e_i,$$

where i refers to females and males and h to households; Y is female (male) wage labor income per household per month; *hours* represents the number of female (male) hours per month spent in wage labor excluding travelling time; *assets* is the value of productive assets controlled by the household in thousands of rupiah, and C/N is the ratio of wage labor participants in the 10–15 age group to total wage labor participants in the household. As is standard practice in earnings function analyses, the estimates exclude households in which there were no female (male) labor force participants. The observations are, therefore, confined mainly to small-landowning and landless households.

The double-log form of the model allows one to test whether the relationship between wage labor income and hours worked is linear in logarithms, which is equivalent to the proposition that wage rates are independent of labor hours. Consequently, the null hypothesis under examination is that α is one. In the tables, the test statistics for the hypothesis that α is different from one are presented in square brackets.

The inclusion of assets as an explanatory variable distinguishes this earnings function from the standard specification. It is generally assumed that the wage rate which an individual can potentially earn is determined by the extent to which he or she has invested in such factors as education, on-the-job training, and

Table 1. Wage Labor Earnings Functions: Females

	Dependent Variable: ln Wage Labor Income						
Month	Phase of Rice Cycle	Constant	α (ln Hours)	β (ln Assets)	γ C_f/N_f	$\bar{R}^2$	n
Wet season							
Nov.	Slack	2.95	0.91 (17.6) [1.64]	0.06 (2.84)	−0.13 (1.04)	0.93	30
Dec.	Transplanting	3.84	0.89 (20.9) [2.73]	0.01 (0.87)	−0.02 (0.13)	0.91	61
Jan.	Weeding	3.11	0.98 (18.6) [0.31]	−0.03 (1.62)	−0.20 (1.27)	0.89	58
Feb.	Slack	2.85	0.98 (32.2) [0.58]	0.002 (0.002)	0.20 (1.99)	0.97	36
Mar.	Slack	2.00	1.15 (33.7) [4.48]	0.04 (1.95)	0.07 (0.59)	0.98	30
Apr.	Harvest (major)	3.22	0.86 (15.4) [2.29]	0.05 (2.29)	−0.17 (1.02)	0.79	67
Dry season							
May	Harvest/ transplanting	2.92	1.00 (24.9) [0.23]	0.03 (1.70)	−0.48 (0.38)	0.90	79
June	Transplanting/ weeding	3.98	0.85 (28.9) [5.19]	0.04 (0.37)	0.18 (1.79)	0.94	63
July	Weeding	2.80	0.99 (24.9) [0.27]	−0.01 (1.06)	0.09 (0.92)	0.94	57
Aug.	Slack	2.52	0.99 (24.5) [0.18]	0.03 (2.46)	−0.10 (1.13)	0.93	55
Sept.	Harvest (minor)	3.46	0.82 (18.3) [4.17]	0.05 (2.26)	−0.12 (0.76)	0.86	61
Oct.	Harvest (mainly outside village)	3.67	0.91 (20.4) [2.40]	0.11 (0.78)	−0.27 (3.10)	0.89	63

Note: t-ratios in parentheses. The t-ratios in brackets test whether the α coefficients are different from 1.

Table 2. Wage Labor Earnings Functions: Males

	Dependent Variable: *ln* Wage Labor Income						
Month	Phase of Rice Cycle	Constant	α (*ln* Hours)	β (*ln* Assets)	γ C_m/N_m	$\bar{R}^2$	*n*
Wet season							
Nov.	Land prep.	3.48	1.01	0.01	−0.68	0.95	57
			(31.4) [0.31]	(0.63)	(6.12)		
Dec.	Land prep.	3.57	0.99	0.04	−0.39	0.90	62
			(23.0) [0.20]	(2.13)	(2.69)		
Jan.	Slack	3.40	1.02	0.01	−0.14	0.78	50
			(13.2) [0.32]	(0.60)	(0.42)		
Feb.	Slack	3.96	0.91	0.02	0.20	0.86	39
			(14.6) [1.45]	(0.81)	(0.78)		
Mar.	Slack	2.76	1.13	0.05	−0.76	0.93	42
			(20.0) [2.43]	(2.47)	(4.25)		
Apr.	Harvest	2.72	1.01	0.08	−0.51	0.71	62
			(12.4) [0.17]	(2.60)	(2.73)		
Dry Season							
May	Land prep.	3.29	1.04	0.01	−0.56	0.85	63
			(17.7) [0.73]	(0.57)	(3.94)		
June	Land prep.	3.49	1.04	0.03	−0.39	0.86	61
			(17.7) [0.69]	(1.78)	(2.90)		
July	Slack	3.02	1.08	0.06	−0.67	0.89	60
			(14.7) [1.17]	(2.87)	(4.57)		
Aug.	Slack	2.78	1.11	0.07	−0.56	0.82	60
			(15.2) [1.52]	(2.89)	(2.91)		
Sept.	Harvest	2.59	1.12	0.08	−0.91	0.84	61
	(minor)		(17.5) [1.87]	(3.93)	(5.29)		
Oct.	Harvest/	3.22	1.05	0.05	−0.54	0.88	59
	land prep.		(19.9) [0.94]	(2.71)	(5.37)		

Note: *t*-ratios in parentheses. The *t*-ratios in brackets test whether the α coefficients are different from 1.

apprenticeship. The formulation used in this analysis is based on the observation that the manual labor in which Javanese agricultural workers engage does not call for such "human capital" investment. There is strong reason to suppose that the relative position of the household in the village class structure is the most important determinant of access to wage labor opportunities. Historical and anthropological considerations (White, Stoler, Collier, Hart) suggest that the household's degree of control over the means of production, primarily rice land, defines its status in the class hierarchy of the village. Within the context of the model, we are testing the null hypothesis that β is zero—namely, that the income which females and males can earn from a given number of hours of work does not depend on asset status.

The variable representing the ratio of child to adult participants (C/N) takes account of the fact that children—particularly girls—in the 10–15 age group are heavily involved in wage labor in poorer households. Especially insofar as males are concerned, the wage rates earned by boys are below those of adults.

In the case of male labor markets (table 2) we can accept the null hypothesis that wage rates are more or less independent of hours worked. The situation in female labor markets (table 1) is more complex. The coefficients for hours worked and their associated *t*-ratios suggest that, in five of the twelve months, women who worked longer hours had to accept substantially lower wage rates than those whose involvement in wage labor was more limited. It is interesting to note that the coefficients are smallest and the *t*-ratios highest in transplanting and harvesting months, both of which are periods when the demand for female rice labor within the village is relatively high. Transplanting is a heavily time-constrained activity concentrated in a short period and offering wage rates approximately twice those for weeding and nonrice labor; the coefficients for December and June indicate that women who wished to work beyond the transplanting period had to accept lower wage rates in nonrice activities.

The situation in harvesting months should be considered in conjunction with the assets variable. Particularly in April and September, activities other than rice harvesting within the village were limited. The relatively low α coefficients and high β coefficients in these months are revealing of the way in which class and labor relations provide wealthier women with more favorable harvesting opportunities, a phenomenon which has been analyzed by Stoler. In other periods, with the exception of November, the β coefficients are generally small and in weeding months negative. These results reflect that in weeding periods there is a substantial amount of low wage employment available for women inside the village and class factors do not play an important role in determining access. In slack periods, particularly in the wet season, virtually all available work was outside the village and women from the small-landowning class tended to withdraw from the labor force.

The structure of female and male work opportunities in the study village is such that class relationships generally play a more important role in providing males with preferential access to high wage jobs. There are, however, certain periods when these factors are less important. These are the peak periods of land preparation when male labor markets are tight, and two months in the slack period of the wet season when ocean fishing on an individual basis offered a remunerative, although risky, alternative to wage labor. In the remaining six months, men from landless households earned wage rates substantially lower than those from the landowning class.

The empirical analysis suggests that the perfect labor market assumption does not provide an adequate basis for assessing the impact of an increase in labor demand on small-landowning and landless households. A more useful approach involves understanding the ways in which control over the means of production shapes both labor supply behavior and access to job opportunities.

Conclusions

The most commonly identified sources of rural employment generation are rural public works and changes in agricultural technology. If we accept that any public works project will function with restricted funds, two policy options are open. First, employment opportunities may be maximized by offering wage rates at or only modestly above those prevailing during the slack agricultural seasons. Second, far fewer jobs may be provided and substantially higher wage rates paid. The low wage rate option would not contribute to the well-being of landless households, especially if participants have to walk long distances. If public works offered higher wage rates during slack seasons, the probability that these jobs would go to members of landholding households is large. Few rural people view public works employment as permanent or reliable. Consequently, the "survival strategy" of the landless would probably induce them to maintain established work patterns. In contrast, self-sufficiency in rice production places small-landowning households in a stronger position to accept the risk associated with this employment. Even if the landless are willing to disregard job uncertainty, there is reason to suppose that the unequal entry to work opportunities would operate against them.

Similarly, the effect of a switch to HYVs is more complex than may appear superficially. Available evidence suggests that, on average, labor inputs per hectare on HYVs do not differ appreciably from those on local varieties. Increases in aggregate rice employment therefore depend on more intensive cropping; for example, three crops in thirteen months, as opposed to the present two crops per year.

This study has shown that the marked pattern of seasonality associated with the cultivation of traditional varieties benefits the landless to the extent that they are assured of high wage jobs in the peak season of rice cultivation. A change to HYVs with shorter growing season requirements would lead to staggered planting, thus generating a far more even profile of labor demand. Given both the responsiveness of small-landowners to job opportunities inside the village, and the system of labor relations which provides this class with preferential work access, it is possible that a widespread shift to HYVs could result in fewer jobs for the landless within the village.

Our concern in this paper has been to explore the forces underlying rural labor market operation on the basis of a micro-level understanding of household allocational strategies and the nature of agrarian class and labor relations. We conclude that in a situation of high labor-land ratios, extensive landlessness and an inequitable structure of asset distribution, there may be marked limitations in the extent to which the usual types of employment programs can address directly the poverty problems confronting the landless.

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Aspects of Rural Labor Market Operation: A Javanese Case Study: Discussion

Peter J. Matlon

In the context of applied research, where the measure of success should be the degree to which a project is implemented, an improved package is adopted, or benefit incidence is accurately anticipated, class analysis that formally incorporates institutional factors often can be an essential complement to conventional neoclassical analysis. The obvious reason is that while development interventions may be both technically and financially sound, local institutional structures often distort their intended impact and restrict access from subgroups defined by these institutions.

Perhaps the most important contribution of the Hart-Sisler paper is the attempt to delineate labor markets on the basis of a class structure as defined by such community institutions. Finding household land ownership closely identified with class status, they demonstrate how tenure-based patron-client relationships and reciprocal wage-labor exchange practices operate to restrict high wage employment to small landowners while bypassing landless workers—this, in spite of no apparent qualitative differences between labor classes. They conclude that given the observed class-hiring practices, the most probable employment effects of rural public works projects and of the adoption of high-yielding rice varieties would be in direct contrast to the outcome predicted on the basis of neoclassical analysis alone and would result in a worsening of the relative poverty of the poorest households.

While one can concur with the validity of their class analysis approach it is not clear what principles could be used to identify the key social factors in other rural environments to delineate distinct farm groups or labor markets. Hart-Sisler employ the simplifying assumption that the land ownership strata coincide with the social/political class structure, and, moreover, that both are closely correlated with income or welfare strata.

This assumption is not unusual. In the absence of accurate data on household incomes, a procedure commonly used in many farm surveys attempting to draw interpersonal distributional implications has been to employ household land strata as proxies for income strata. But technical factors alone are in many environments poor proxies for social class, and land size in particular may often be an extremely inaccurate proxy for income or welfare status. The approach is strictly valid only where there is little variation across households in family size, in returns to land, and in proportion of income derived from off-farm employment. Where these conditions do not hold—for example, note the wide range in the proportion of off-farm income across the Java land strata—the approach can be extremely unreliable.

As a crude test of the sensitivity of the Hart-Sisler results to factors within Java, it is useful to compare the following relationships found in that setting with data from importantly different rural areas:[1] (*a*) household land status is closely correlated to total personal incomes and thus serves as a close proxy for income or welfare status; (*b*) income derived from off-farm employment is inversely related to household land holdings; (*c*) returns to labor in off-farm employment are directly related to both land and income.

Table 1 shows the relationship between land holdings and size and composition of household income in rural areas of Sierra Leone and Northern Nigeria. In both areas size of land holding is poorly correlated with both income per household and income per consumer man-equivalent in the small landholding

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[1] Farm surveys were conducted in both Sierra Leone and Nigeria during 1974–75 to obtain the data cited. The Sierra Leone survey covered 500 rural households randomly selected throughout the country. Data in the Nigerian survey were obtained from 100 farming households in three villages located in southwestern Kano State. Both survey areas are characterized by low to medium population density as reflected in 77 and 130 persons per square mile in Sierra Leone and Nigeria, respectively. Landlessness is lacking in both regions.

Table 1. Size of Land Holding and the Level and Composition of Household Income

Country	Size of Holding (acres)	Total Household Income ($)	Consumers Per Household	Income Per Consumer Equivalent ($)	Household Income from Nonfarm Employment	Percentage Nonfarm Income in Total Household Income (%)
Northern Nigeria: 1974	0–2.46	479	3.1	154	273	57
	2.47–4.93	377	3.1	120	117	31
	4.94–7.40	569	4.4	130	148	26
	7.41–9.87	769	5.3	146	115	15
	9.88+	868	5.1	171	208	24
Sierra Leone: 1974	0–.9	587	4.3	135	223	38
	1–4.9	404	3.6	111	93	23
	5–9.9	546	4.2	129	76	14
	10–14.9	770	6.1	127	100	13
	15+	927	5.6	167	83	9

Sources: Northern Nigeria: P. Matlon; Sierra Leone: AREP.

strata. That is, land holdings alone serve as a particularly inaccurate proxy for the identification of poverty groups.

At least two factors contribute to this pattern. First, bigger families tend to cultivate larger farms. In contrast to the Java case this reflects continued access to surplus land such that acreage can be expanded in line with additional consumption requirements and available manpower. Second, in both absolute and percentage terms, off-farm incomes are greatest for households with the smallest holdings. Again, in contrast to Java, it is important to note that off-farm incomes remain substantial in absolute terms among even the largest landowners. In Nigeria, in particular, this reflects earnings realized from the reinvestment of surplus farm product in dry season off-farm trading activities.[2]

When the African data are disaggregated into income classes, even more substantial differences can be seen in contrast to the Asian environment. It is recalled that in the Java village there was a strong inverse association between the proportion of off-farm income and asset status. In comparison among Sierra Leone farm households, a nearly constant 20% of income is derived in off-farm employment, irrespective of income class. And in Nigeria, off-farm income increases in importance from 22% among households included in the poorest third of the sample to 35% among the richest third. Important income-related variation in the types of off-farm employment were observed, however, in both African countries. Members of poorer rural households tend to find employment in service occupations that utilize little or no working capital and that realize low returns to labor. In contrast, occupations pursued by higher income households typically require ownership of fixed assets and/or substantial expenditures on working capital, and earn significantly higher returns. Thus, while job-related variation in off-farm wages were found to contribute to a widening of income differentials, the explanation did not rely on institutional rigidities separating labor markets, but rather on differences in levels of surplus capital available for off-farm investment.

Conclusions

I would conclude by saying we must be very careful in drawing the right conclusions from the Hart-Sisler paper. They provide an excellent example of policy-relevant class analysis and demonstrate how standard neoclassical analysis may result in misleading policy approaches. But their reliance on land strata as the primary disaggregating factor must be treated with considerable caution. While assets in the form of land holdings may be a critical variable with which to delineate off-farm labor markets (and less clearly income strata) in land-short Java, this criterion may well be inapplicable in other low income environments. The danger of relying on landholdings as the fundamental class-stratifying criterion over a range of conditions should be clear at this point, but it warrants re-emphasis because of its continued inappropriate use in much current rural economics research.

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[2] An exhaustive survey of data from a wide range of developing countries is now underway at Michigan State University to examine the relationships associating off-farm income and employment to key factors in the environment and to stage of development (See Chuta and Liedholm).

Moreover, although Hart-Sisler qualify their conclusions as relevant only in areas characterized by low land/labor ratios, highly inequitable land distribution among owners, and high landlessness, it is not clear that their results are generally applicable even within such areas. Rather, the critical factors in the Java case would appear to be (*a*) the practice of pawning land which results in the formation of patron-client relationships, (*b*) reciprocal wage labor exchange by "invitation," and (*c*) poorly developed rural nonfarm employment opportunities. In the absence of these very specific conditions, it is not clear why either the reintroduction of high yielding varieties or programs of rural public works should lead to an increase in the relative poverty of the landless. Nor is it clear how stable these labor relationships would remain in a more dynamic environment.

The question remains as to how one in practice delineates appropriate farm classes employing social/political criteria for any given environment; and further, whether agricultural economists are particularly competent to identify and interpret such variables in any event. We might note that institutional variables have been more thoroughly incorporated into the domestic policy and extension fields. But in international development, agricultural economists rarely go beyond a consideration of land tenure factors, considering the wider range of institutional variables to be the stuff of radical economists, sociologists, or anthropologists. This is both unfortunate and unnecessary. To claim that we lack the formal training to be fully competent to address these issues is undoubtedly true to a degree. But until such training is considered an integral part of our background, we can at least begin by asking some of the right questions to qualify and help refocus our work. I suggest that the following four questions provide a useful starting point: (*a*) What market imperfections are present in the system under study? (*b*) What, if any, are the institutional rules which cause or reinforce these imperfections? (*c*) What subgroups or classes are defined by these rules? (*d*) How stable are these rules and classes in a changing environment? And can we predict their interaction with policy interventions?

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Improving Managerial Capabilities of Limited Resource Farmers

K. J. McKenzie

As farming technology in North America continues to advance and relative prices of farm products and farm inputs change, there is continued downward pressure on the real incomes of producers who do not make appropriate adjustments. As in the past, such producers frequently have relatively limited resources, even though the resource base and scale of farm operation of those currently in difficulty is typically larger than it was a decade ago. In Canada, approximately one-third of the country's 300,000 farmers had net taxable incomes of less than defined poverty levels in 1974 (Darcovich et al.). Of these, about 62,000 relied primarily on farming for their livelihood. The majority (85%) of this group had farm product sales of less than $25,000.

Such a producer typically faces four options—give up farming and take up nonfarm employment, develop his farming business into a larger and more prosperous enterprise, combine farming with off-farm work or some nonfarm business activity, or continue to operate his farm much as he has done in the immediate past. Because of the technical skills required, and the relatively high unemployment rates in some nonfarm sectors (particularly in regions where many of these farms are located), the first of these options is often not as viable as it once was, even though the numbers of farmers who potentially might take advantage of it is currently fewer. Furthermore, this option is usually inconsistent with such general social goals as maintaining a reasonably balanced population distribution and accelerating economic development of disadvantaged regions. The fourth option is particularly unsatisfying from both an individual and social point of view. However, it should be noted that much of the agricultural adjustment that has taken place in Canada over the last two decades has probably been achieved via this mechanism (i.e., by major changes in the organization of individual farms upon the retirement of operators who have adjusted little, especially during the latter part of their careers).

If a limited resource farmer is going to be an effective contributor to economic development, he must vigorously pursue either the second or the third of the above-mentioned options. In Canada, a variety of mechanisms have been employed to assist limited resource farmers in this regard. Some such programs have concentrated on technology transfer, others on capital expansion, still others on training in financial planning and economic decision making. In the area of capital expansion, special credit and capital grant programs have been used. In the area of technology transfer, commodity-specific advisory programs and one-to-one counselling have been common. In the financial planning area, credit advisory and farm accounting services have been used widely. In some cases, a combination of two or more of these elements have been employed in the same program. Because of the limited enthusiasm for part-time farming among Canadian policy makers, relatively few, if any, efforts have been made to assist low income, full-time farmers become higher income part-time farmers.

While the net effect of all these programs probably has been beneficial, the programs themselves generally have exhibited certain deficiencies. Some of them have been very high cost in terms of the time and effort required for individual producers. Others, especially capital grant programs, while giving the appearance of generating significant changes and (not surprisingly) being very popular among program participants, appear to have produced little in terms of achieving a viable, self-sustaining farming sector.

While advisory programs generally have been effective in increasing farm incomes in the short run, some have led to situations where clients depended too heavily on ad-

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visors. In these cases, a withdrawal of advisory assistance was followed frequently by poor decisions which reduced or eliminated initial income gains. It is also significant to note that, even though many resources have been devoted to this problem area in the past two decades, we still have a limited-resource farm problem, and this is usually most noticeable in regions where the greatest effort has been made. Additionally, it is possible to identify a number of individual cases where special financial assistance appears actually to have made the program participant worse off.

This paper argues that the objective of such programs should not be simply to increase the incomes of program participants. It should be to develop their managerial capabilities to a level where they themselves will ensure that their businesses will continue to grow and develop. Thus, largely on the initiative of the individuals involved, these enterprises will continue to adjust so as to ensure that any short-run income gains are not eroded in the future, and that these, in fact, are expanded and increased over time. It is suggested that, by focusing on such an objective, we shall truly be directing our efforts at making limited resource farmers both effective contributors to, and satisfied participants in, economic development.

If we are to pursue such an objective, we need to identify clearly what we mean by improvements in the managerial skills of farm operators, and to establish how the achievement of such improvements would differ from what we traditionally regard as farm management work. This is not to imply that traditional farm management programs have not brought about improvements in farm management capabilities. They undoubtedly have. However, a review of their nature and apparent impact leads one to advance at least one significant hypothesis regarding the effectiveness of this approach.

In the past, much farm management work in Canada has grown out of advisory programs of a largely technical nature. Additionally, in the last ten to twenty years there has been an increasing emphasis on financial planning and the application of conventional economic decision-making rules and procedures. A major emphasis has been placed on farm accounting and a national, computerized, farm accounting system (CANFARM) has been established. All of these efforts have been received with interest and enthusiasm by selected groups of Canadian farmers. However, many other farmers have expressed little interest in such programs. In some cases this appears to have been because these farmers did not need such assistance; and in others it seems to have been because they could not see the relevance of such programs to their particular situations. As already noted, special attempts have been made (with varying degrees of success) to involve limited-resource farmers in some such programs. Meanwhile, many aggressive, commercial farm operators have made substantial progress in developing their businesses with limited exposure to farm management extension programs. And, this progress was sometimes (or perhaps even frequently) achieved with little formal training in some of the materials being studied by their colleagues who were participating in such programs.

This leads us to put forward the idea that good managers have a conceptually different orientation to management than poor ones, and that this orientation is of a more basic nature than the standard technical, financial, and economic matters that are customarily dealt with in applied farm management extension programs. Such a managerial orientation logically leads good managers to seek out the technical and economic knowledge they require, to carry out the relevant sorts of analyses for different problems facing them, and to develop and apply effective managerial tools to assist them in so doing. It is also hypothesized that farmers who readily participate in farm management extension programs have sufficient basic managerial orientation to identify their need for further knowledge and skill improvement. Successful managers who do not become involved in such programs have probably already acquired equivalent (or superior) knowledge and skills on their own. Poor managers who are not attracted to such programs have insufficient basic managerial orientation to appreciate their usefulness and to select the ones with the most relevance for their particular situations. Many, but by no means all, limited resource farmers appear to be in this latter category.

The advancement of such an argument logically leads one to search for a conceptual framework that enables one to describe, in simple, teachable terms, the essence of successful management. There are two approaches which, when combined, appear to have considerable potential for providing such a framework. These are the rational approach to management (such as that developed by Kepner and Tregoe) and the creative approach (such as that described by Prince). While both of these approaches have been developed largely for nonfarm businesses, and usually applied to large organizations, they appear to have sufficient flexibility to permit adaptation to the management of farming enterprises. Furthermore, if used carefully, they will only complement, not replace, existing approaches to farm management work.

The rational approach described by Kepner and Tregoe suggests that the manager must deal with three distinctly different types of managerial situations: (*a*) problem identification (what went wrong?); (*b*) choosing an option (taking a decision); and (*c*) problem anticipation (what might go wrong?). This framework reflects the temporal character of the management function. Managers must make decisions while looking both back and forward in time. The expected results on which decisions are based become the performance criteria against which projects, activities, or enterprises must be judged as they proceed. The monitoring of enterprises or projects, and the making of adjustments when things go wrong, is equally important as the taking of major decisions and the planning for how to implement these decisions. The problem anticipation function is really a mechanism for developing a successful implementation plan.

It would appear that a manager with a sound grounding in this approach who was asked to manage a farm, but knew nothing about farming, very likely soon would be doing most of the things that we already know good farm managers do (McKenzie 1977). He would get detailed information on the alternative enterprises possible, make a logical comparison of them, choose a plan of action, utilize performance criteria such as income, crop yields, livestock growth rates, etc. to monitor his plans and ensure that they were proceeding as required. General plans and performance criteria would be used to devise detailed, specific, performance measures (e.g., is seeding proceeding on schedule?) to guide day-to-day and week-to-week activities. The technical knowledge required to do this would be obtained by the manager through following a logical process of determining "what might go wrong" and assessing what he could do to prevent this or to minimize the impact of disasters he could not control.

The problem analysis function is facilitated by defining a problem as an undesirable deviation between what should happen and what actually does happen. This permits generalizing the analysis function to apply at any level in the farm business. Day-to-day problems include such things as tractor breakdown and sick animals. More general problems include low crop yields and, of course, low net returns. The Kepner-Tregoe version of the rational approach emphasizes the logical determination of problem causes under the assumption that the manager often will be able to eliminate these or reduce their impact on desired results. For many farming problems, e.g., low prices and low yields due to poor weather, farmers can do nothing about eliminating causes. Thus, greater emphasis on adaptive action and strategies for dealing with risk are required. Nevertheless, the logical determination of problem cause still is relevant, for without knowledge of this, appropriate solutions are frequently not discovered.

Most rational approaches to the basic decision-making function contain similar concepts to the basic micro production economics we are all familiar with. Some lead one to consider nonmonetary consequences much earlier in the process. Kepner and Tregoe emphasize the segregation of values into two basic categories—"musts" and "wants." The latter increases decision-making efficiency by forcing one to discard irrelevant alternatives quickly. Basic micro production theory can have the opposite effect if not applied carefully.

Potential problem analysis involves the detailed examination of selected courses of action to determine what might prevent their successful execution. As a result, the manager may either return to reexamine his original decision or develop a detailed implementation plan for the proposed course of action. Such a plan will include a variety of preventive measures as well as different types of insurance or contingency plans for problems whose cause may be beyond the control of the manager. For example, if harvesting is a critical point in the farm operation (as it often is), the successful manager will likely have several back-up plans prepared in advance for such problems as major machinery breakdown or loss of hired help.

The concept of a problem can be inverted to provide a useful definition of an opportunity. An alert manager with established measures of performance for his business will continually be looking for ways to improve these indicators. He monitors new technical information sources looking for ways to improve crop yields, reduce costs, increase labor productivity, improve machinery effectiveness, and so on. When he identifies a potential opportunity, he swings into a decision-making mode and assesses the new idea against what he is already doing. It is a simple and easy step once the concepts of problem identification and decision making have been mastered and a comprehensive set of performance indicators for the business have been established.

The combination of creativity with a rational management process such as that developed by Kepner and Tregoe provides one with a powerful conceptual framework for developing managerial training programs. Creativity may be viewed by some people as an inherited talent rather than one which can be developed. It may also be considered as an essential characteristic of the artist or the advertising specialist, but not really necessary for a successful farm manager. Nevertheless, it must be acknowledged that there are really only two ways to identify opportunities for improved business performance—copy something someone else has done, or come up with a new idea yourself. As individual situations differ, the first possibility frequently breaks down. It is often not a case of doing exactly what someone else has done but one of adapting it to one's own situation. Additionally, the unique features of some smaller farms dictate that, without creative ideas, there is little hope for much income improvement.

The process of creative thinking can be broken into two elements—one pertaining to the establishment of goals, and another focused on identifying how to achieve these. The goals are, of course, closely related to the performance indicators established by the rational manager. They may, however, include both new measures of performance and, in the case of existing indicators, levels of performance not previously conceived of as possible. The ability to conceive of such goals quickly can be readily cultivated. The process of quickly sorting such goals to establish priorities and identify goal hierarchies also can be developed. The mechanisms for discovering new ways of goal achievement are more complex, but there is evidence that these can be developed as well.

Conclusion

In summary, this paper has argued that increasing the managerial skills and capabilities of limited resource farmers is a potentially effective way of enabling them to contribute to, and participate in, economic development. Conventional farm management extension programs by themselves often are not highly effective in achieving the required increase in managerial capabilities. It would appear that, for many limited resource farmers, a different basic managerial orientation often needs to be developed prior to, or along with, conventional farm management training. A combination of the rational and creative approaches to problem solving and decision making currently being used in industry appears to have the potential for providing a conceptual framework upon which to base programs directed at fully developing the basic managerial orientation of limited resource farmers.

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Improving Managerial Capabilities of Limited Resource Farmers: Discussion

Leroy Davis

McKenzie's paper suggests a new management-training technique or approach to management problem solving for small or limited resource farmers. No distinction is made between the terms "limited resource" and "small." The terms are frequently used interchangeably in the literature (Williams). Both terms refer to farm operators who have relatively smaller quantities of the factors of production than the average size farm (*The Family Farm in California*). However, in many instances, small farmers are believed to have an abundance of labor or are labor-intensive. This implies that small farmers have a potential comparative advantage in the production of labor-intensive enterprises such as fruits and vegetables. This notion is not considered by McKenzie. McKenzie proposes his model is applicable to the livestock-based enterprises in Canada. Labor-intensive production has been suggested as a partial solution to the current energy problems. As aptly pointed out by Marshall and Thompson (p. 2), "Increasing energy prices, continued pollution growth, and food shortages will require the world to feed itself through labor intensive techniques."

Two models are borrowed from modern management science, the Kepner-Tregoe technique and "synectics." These techniques are used fairly commonly in business and industry. McKenzie sees these models in combination as a panacea for the small farm management problems. The models are also considered additive, complementary, and compatible. It is not clear whether the two models, if combined, are as effective as McKenzie would have us believe. These models do provide an orderly and structured approach to management problem solving, but the applicability to limited-resource farm management problems is not readily plausible.

The contributions of traditional farm management and production economics to commercial agriculture is recognized by McKenzie. However, McKenzie feels traditional farm management techniques are not effective when applied to limited-resource farmers. McKenzie forgets that attitudinal characteristics of small farmers are created by environmental conditions rather than inherited. I would argue that farm management techniques have not been learned or utilized fully by small farmers. Most small farmers are not exposed to good management practices (*Missouri Small Farm Program*). If the traditional farm management practices are applied correctly over a sufficient time period, success will undoubtedly be forthcoming. I think Marshall and Thompson argue correctly in that, "It is not at all clear whether large-scale farmers are intrinsically more efficient than smaller ones or whether their apparent efficiencies are due to policies and personal characteristics subject to change by policy interventions" (p. 2).

McKenzie is only partially correct when he argues that we do not simplify management techniques enough to be adequately comprehended by small farmers. However, demographical studies of small farmers reveal a wide range of educational levels (Davis). Although some small farmers have educational attainment beyond the college level, the distribution of educational attainment of small farmers is skewed toward the lower levels. On the other hand, age distribution is skewed toward the higher values. And there is a wide range of levels of farming experiences among small producers. Many have been farming more than forty years; others are young farmers who are just entering the industry. There also is a vast difference in the training needs of small farmers. These differences will vary across geographical locations and enterprise types. Small farmers in developed countries are quite distinct from small farmers in the developing world. Small farmers in the southeastern United States are significantly differ-

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ent from small farmers in the Midwest. Thus, any applied program of remedial management practices must be geared to reflect these differences.

McKenzie is correct when he states we must take the small farmer as he is and move him forward from his given point of departure. However, the traditional farm management techniques must be incorporated into the management training scheme. The traditional farm management techniques are the tools for proper management. These tools have been demonstrated to be necessary for effective management. The small farmers have not grasped these tools fully or completely. Most small farmers do not keep records for decision making. Without records it is impossible to allocate productive resources rationally and enterprise budgets cannot be computed. Long-range planning for growth and development will be impaired seriously in a system without facts. Few small farmers are familiar with estate planning and land transfer techniques. This has led to a serious decline in the number of acres of farm land held by small black farmers in the United States. There also is some confusion between management skills and management tools in the McKenzie paper. The tools are applicable to the small farmer as well as the large farmer, but small farmers must be trained to develop the skills to use the tools and properly interpret and use the results.

One apparent weakness of the McKenzie approach is the lack of empirical evidence that the technique is effective with farmers. There are no case studies or demonstration projects to indicate the applicability or effectiveness of these techniques. Practical applications of Kepner-Tregoe and synectics have been used in industries with very large firms. These firms are highly stratified in their decision-making processes. These managers are trained to make only certain types of decisions in a well-defined framework and they also are experienced in accepting training and adjustments to new innovations. A small farmer is hardly the same caliber of person as the middle level manager in business and industry.

McKenzie proposes to train extension workers with the new management techniques. Extension workers will, in turn, train the small farmers. However, extension workers are not managers or decision makers. In most cases extension workers do not operate farms; occasionally extension workers do not have farm backgrounds. Much of the criticism for the plight of small farmers has been focused on the philosophy and practices of the extension service. McKenzie fails to consider this argument. It is not at all clear how the methods and philosophy of the extension service will be transformed with the mere addition of new management techniques.

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The Impact of Public Policy on the Control of Agricultural Resources
(Paul W. Barkley, Washington State University, Chairperson)

Public Policy and the Control of Agricultural Production

Bruce L. Gardner

The control of agriculture, and its relationship to the economic organization of agriculture, has become a widely discussed issue, but with little of factual or analytical substance on which to draw conclusions. The effect of U.S. public policy upon structure and control has been central to the discussion. This paper is a review and assessment of the present state of knowledge about the relationships between agricultural policy and structure, and between policy and control, in the United States.

Public Policy Areas Influencing Agriculture

The main policy areas which are likely to have influenced the structure and control of agricultural production are (*a*) commodity programs, (*b*) tax policy, (*c*) public research and extension, (*d*) allocation of publicly-owned or subsidized resources, and (*e*) credit and insurance programs. In addition, policies directly aimed at corporations in farming, regulatory activities in the environmental, transportation, and labor areas, and policies relating to agricultural cooperatives and bargaining should be considered. For a detailed program list, see Moore. It is impossible to give all of the policy areas the detailed scrutiny they each deserve within the scope of one paper. This paper will focus on several of the most commonly discussed.

Farm Commodity Programs

There has been substantial work on two structural consequences of commodity programs: the effects on farm size and the effect on the inequality of the distribution of returns. The general view among agricultural economists appears to be that historical and current commodity programs, taken as a whole, work to increase average farm size (Quance and Tweeten; Penn and Boehm; Moore; Dorow; Kyle, Sundquist, Guither) and to widen the distribution of returns (Gardner and Hoover, and references cited therein). However, on farm size the evidence is not solid, and on both issues the relevance of structural effects for control of agriculture has not been established.

Two a priori arguments why farm commodity programs should increase average farm size are prominent in the literature. One, as applied by Penn and Boehm to the Food and Agriculture Act of 1977, is that regulated producer prices at a national average cost of production level will improve the economic position of "low-cost" relative to "high-cost" producers.[1] On the low-cost side, "the target price levels will allow these producers to secure windfall gains. The smaller, relatively higher cost producers may not be substantially assisted by the program, depending upon their actual cost level" (Penn and Boehm, p. 12).

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[1] The terms "high-cost" and "low-cost" are put in quotation marks because their meaning is not obvious. Both "high-cost" and "low-cost" producers should tend in the long term to have average cost equal to price when the value of assets which account for the cost differentials are taken into account. Low-cost producers may best be thought of as "rent-earning" producers who receive above-normal returns to management, land, or another specific factor or production.

It is true that if it costs a wheat producer more than $3.40 per bushel to produce a crop, then a $3.40 target price will not prevent losses. But, it does not follow that high-cost producers benefit less from price supports or that a price support program will encourage a faster replacement of high-cost by low-cost producers than would occur in the absence of price supports. Whether high-cost producers are helped more or less than low-cost producers by a commodity program should be judged by comparing their respective situations with and without the program. The change in net returns per bushel caused by the program is the same for both high- and low-cost producers. Who is helped most depends on to whom a given dollar increase in net return per bushel is worth most. While it is difficult to determine the answer to this question in general, the most plausible case of exceptionally great assistance would be help for a farm that would otherwise go out of business. Such a farm would tend to be among the high-cost farms, suggesting the opposite of Penn and Boehm's position. However, there remains a reason why a target price program may lead to structural change toward larger farms. The low-cost producer should tend to find it profitable to expand production while high-cost producers may not; and the elasticity of supply may be higher for low-cost producers. The importance of this effect should be increased under the Food and Agriculture Act of 1977 by the abolition of historical acreage allotments.

A more subtle argument for structural effects of farm programs works through the reduction of price risk. Pope and Gardner discuss three ways in which policies that reduce risk can increase farm size: (*a*) increased output by risk-averse producers with given factor and product prices, (*b*) increased input supply by factor owners, (*c*) encouragement of adoption of decreasing cost technologies. In addition, risk reduction under a given technology has been hypothesized to induce increased specialization (among farm enterprises as well as specialization in commercial agriculture as opposed to a mix of on- and off-farm work by the operator). The fact that the ratio of net family income to gross receipts becomes smaller as we move to larger-scale operations means that risk increases with size, *ceteris paribus*. Example: A one-man operation on 200 acres of owned land in corn might have $40,000 in normal sales and $25,000 in normal expenses for a $15,000 return to operator labor and land. By adding rented land and larger machinery and/or hired labor, the operation might have $100,000 in normal sales and $80,000 in normal expenses for a $20,000 operator return. If there is a 10% chance of corn revenues 20% below normal, the small operation bears a 10% risk of net income of $7,000, while the large operator bears a 10% risk of net income of zero. Thus, the risk of severe financial pinch is greater for the large than for the small operation, despite the higher normal income for the large farm. Price stabilization by means of commodity programs reduces the risk in moving to a larger-scale, specialized operation, and might therefore encourage such shifts. However, it is necessary to consider the structural consequences of risk-bearing in the absence of commodity programs. Many private-market substitutes for government stabilization programs, such as forward sales, involve investment of time and money, which may itself contribute to observed economies of size. Thus it is not clear that risk reduction through government stabilization will induce more rapid structural change than its absence.

Unfortunately, evidence to establish any program effects as empirically important determinants of the structure of agriculture is lacking. And with respect to commodity programs in general, there are not reliable estimates of how the size of farms would have grown historically in their absence. One crude test is to compare the experience of commodities with varying programs. The data available suggest, if anything, that the absence of commodity programs is associated with more rapidly increased scale of operation. The clearest case is tobacco, which is a program that is generally recognized as oriented towards small producers by means of its marketing quotas. Cotton is also suggestive in that the average acreage per farm grew more rapidly in the 1969–74 period, during which the program ceased to have an important impact.[2] Corn and wheat show something of the same effect, especially when contrasted with soybeans. In the 1969–74 period, when corn and cotton moved from protected to unprotected status, the rate of growth of average soybean acreage slowed. Since 1930 the average acreage of potatoes, sweet potatoes, and other vegetable crops managed to grow more rapidly than any of the major crops despite a lack of commodity program protection in recent years. Granted, causes other than commodity programs are involved in each of these events, and average crop acreage per farm may not be a good indicator of scale. Nonetheless, one would expect that if commodity programs had in fact been an important cause of large-scale farming, this fact would show up more strongly in the acreage data than it does. Moreover, for commodities such as broilers, eggs, and some vegetables which have experienced great change in organization and control unrelated to acreage, commodity programs are conspicuous by their absence.

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[2] The statements in this paragraph are based on crop acreage and numbers of farms producing the specified crops reported in the Census of Agriculture, 1930 through 1974.

There is no necessary connection between reduced numbers of farmers and increased concentration of production on the largest of the remaining farms. For example, if the number of sugar cane producers were reduced to 1,000, it would make an important difference whether they each produced roughly equal quantities or whether the largest five accounted for 50% of output and the rest were small. As a matter of fact, concentration of U.S. production on the largest farms, as measured by Gini ratios or the coefficient of variation of the size distribution of farm sales, has increased as U.S. farm numbers have been reduced. Nonetheless, while the effects of commodity programs in increasing the inequality of farm income are fairly well established, the effects on concentration of production are not.

Marketing Orders and Agreements

The use by agricultural cooperatives of marketing orders and agreements may be thought of as a form of commodity policy. LeVeen says, "There is some evidence that suggests that market orders and the implementation of quality standards are biased against the smaller producers" (p. 30). While we may readily accept Jamison's conclusion that the management of marketing order controls "reflect to a larger degree the desires of some prominent grower leaders" (p. 249), it is not clear that the controls implemented make it more difficult for smaller growers to survive than would be the case in an unorganized market. This is true even if the marketing controls aim at keeping prices high enough for only the lower-cost producers to prosper, in that price presumably would have been lower still in the absence of controls.

In moving from questions of structure to questions of control of agriculture, or from structure to performance in the industrial organization jargon, it seems apparent that the issues are more directly related to marketing than to production. The legislation authorizing marketing orders and the special tax treatment and antitrust exemption for some aspects of cooperative activities is in part intended to centralize control of agriculture. The economic justification is the necessity to counter concentration among buyers of farm products. The prevailing judgment seems to be that the legal protection provided to producers is sufficient to the purpose, suggesting that meaningful market control is more readily achieved by having the government on your side than by producing in a concentrated industry.

This notion leads to a different aspect of control in agriculture: control of commodity policy. It could be that in 1978 the American Agriculture Movement's militants have exercised more control over agricultural markets than any other individual or organized group. Analyses of policy tend to be oversimplified in treating policy as exogenous, like the weather. Policy is too often treated in this way until the end of the discussion, at which point it is suggested how "we" could change it if we desire change. It might be more fruitful to examine how the structure of agriculture influences policy instead of how policy influences structure.[3] There appears to be enough mutual reinforcement between structure and policy to cause a certain stickiness in structural change. For example, a small-farm structure of tobacco production influenced the tobacco program, which in turn helped preserve the small-farm structure of tobacco growing. Countries such as those in the European Community seem to have been more strongly affected by this source of inertia than has the United States.

Tax Policy

The superficially most apparent structural aspect of federal income and estate taxes is their progressive feature, with higher income and wealth taxed at higher percentage rates. This progressivity should be expected to have a damping effect on scale insofar as larger scale generates higher incomes and places operators in higher tax brackets. However, the tax code has incorporated exemptions, deductions, and other provisions which enable an operator to increase wealth by investment without incurring the tax liabilities that a first glance at the tax tables might suggest. In 1974, net farm profit according to IRS income tax statistics was $5.0 billion, while realized net income as estimated by USDA was $27.7 billion. Thus, effective income tax rates are far below nominal rates, and it is quite likely that the progressiveness of the income tax is substantially reduced if not eliminated completely. However, as Baker and Hopkin show (p. 1056), the growth of the farm firm tends to be hindered by even a proportional income tax. Moreover, the hindrance increases the more highly leveraged and the more profitable the farm.

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[3] "I doubt that our present price and income policy will prove compatible with an industrialized food and fiber industry. And, if I am correct, the policy is likely to change rather than the industrialization process" (Hathaway, p. 56).

Another area of taxation which has received considerable attention is the role of federal estate taxes, especially as modified by the Tax Reform Act of 1976. The structural consequences of the changes in the 1976 Act are not apparent. The tax rate schedule was made more progressive, and rates increased for larger estates. For example, the federal estate tax amounted to 29.5% on a taxable estate of $500,000 under prior law but is 31.2% under the 1976 Act. Moreover, an estate with the same real taxable value would have been taxed at 26.7% ten years ago. The increased rates, however, are more than offset for many by provisions to value farmland at use value and to permit deferred payment of tax bills. The net result should be an increased ability to pass a large farm to one's descendents without having to sell all or part of it to pay the taxes. Whether this will have any appreciable effect on the size of farming operations remains doubtful, even if it does permit larger fortunes to be accumulated by farm families. Moreover, when judging the effects of taxation, there is always the question of the alternatives being considered. Both before and after the 1976 Act, large estates are taxed much more heavily than small ones. The net effect of estate taxes, albeit much moderated by the options for avoiding them via transfers before death, must be to discourage the growth of a farm family's wealth compared to the situation with no estate tax or a flat rate tax.

In sum, neither the theoretical basis nor the empirical evidence to estimate the structural consequences of our tax laws exists at present. I concur with Dorow's assessment that "no unequivocal answer may be given to questions about tax advantages for larger or small firms" (p. 46).

In considering the issue of control of agriculture, concentration of production, while important, is not the whole story. A degree of concentration in agriculture even mildly alarming by the lights of the industrial organization literature is not on the horizon. Nonetheless, it would be premature to dismiss control issues as pseudo-problems.

The basic idea of "control of agriculture" needs to be looked at more carefully than has typically been done by agricultural economists. There are many forms of control, only some of which become policy issues. In the strict sense of control as determination of events, it is hard to find any instances of control when social interaction is involved. A farmer may be said to control his use of fertilizer or his purchases of feeder cattle, but he is constrained by actions of the fertilizer supplier, the price of fertilizer, the requirements of his banker, his health, and so forth. It would also not be correct to say that the fertilizer supplier controls a farmer's fertilizer use because the farmer may take his business elsewhere, change his production plans, or the economics of fertilizer availability to the supplier may change. An agent's control of an event may be thought of quantitatively as the probability that the event occurs according to the agent's intentions. Control seems to become a policy issue when an individual's ability to influence events involving his own actions is reduced or threatened.

Analysis of control in this sense requires consideration of elements of the economic organization of agriculture other than the concentration of production on large farms. When economic activity is undertaken jointly any individual involved loses control. Suppose two owner-operator farms combine. Even if one of the farmers becomes a hired employee of the other, both would be expected to have less control over the joint operation than either had over his own (although the employee presumably gives up more control than the employer). If an owner-operator sells his land to an urban resident, and then becomes the urban resident's cash or share tenant, there is a real sense in which farm residents have lost control of agriculture. If a farmer accepts contracting arrangements such as have become the norm in some commodities, notably poultry and vegetables, there is an even greater loss of control.

Tax "loopholes" have been cited as an important cause of structural change involving loss of farmer control of farming operations, because nonfarm capital is induced into farming activities to take advantage of lower effective tax rates on returns to agricultural investments, especially those for which returns may be treated as capital gains for tax purposes. While the size of the induced capital flows are uncertain, the question remains how the tax provisions change the amount of capital per farm operator or the contractual arrangements governing farming. The effect of an influx of nonfarm capital on the choice of combination of inputs or the desired size of farm operations is largely unexplored territory. With respect to contracting, however, it seems self-evident that nonfarm capital in farming by definition involves the kind of joint venture which inevitably involves loss of operator control.

Economists have a set of generally-accepted policy prescriptions for industrial concentration leading to market control, but not for control of production as lost in joint ventures and so forth. This empty box leads to the "people are concerned" approach. An example is the series of publications by the North Central Public Policy Education Committee. The reports begin with the existence of "concern," then present data on structure and discuss future trends. But in the end they are unable to say whether the initial concerns are or appear to be justified in any policy-relevant sense.

However one views the normative issues involving control, recommendations for action to counter the effects of tax policy are or should be restrained by the lack of evidence that tax policy has had any strong effect on the structure or control of U.S. agriculture. Loss of owner-operator control should show up as an increasing importance of hired labor in farming or decreasing importance of land operated by the owner. However, since 1920 there has been a slight trend towards fewer hired farm workers relative to the number of farmers. Despite the substantial changes in economic organization and increase in scale of farming, there were estimated to be .52 hired workers per U.S. farm in 1920 and .46 hired workers per farm in 1974. With respect to land ownership, there was a decline in the percentage of land in farms operated by full owners from 48% in 1920 to 36% in 1940, but the figure remains at 35% in 1974. And the proportion of farm real estate transfers in which the buyer is identified as a nonfarmer has been roughly constant at about 37% throughout the post-World War II period.[4] The structural changes involving contracting have been more dramatic in broilers and some vegetables. But this specificity by commodity suggests that the U.S. tax laws are not a prime cause of these developments.

Public Research and Extension

Public research and extension is thought by many to have increased the size of farm operations, although Breimyer, and Guither, Krause, and Bottum have questioned this view. In a proper examination, the effects of public research and extension must be compared with the relevant alternative. The relevant alternative is the conduct of research and extension in the absence of public activities in these areas. If agricultural research and extension were left in private hands there would be two kinds of consequences which work in opposite directions. First, because of its public good character there would be a smaller commitment of resources to research, which would slow down the rate of technical advance and associated structural change. Second, there would be a less wide distribution of research results and instructions for implementing these results, which would increase incentives for large-scale ventures to cover the fixed costs of acquiring information on new techniques for which the producer must pay the full price in a private market. Which set of consequences would dominate is not clear a priori, and the relevant empirical evidence does not exist. The best systematic investigation of the subject is reported by Welch (1970b), who finds that public research has a small effect taken by itself but that in conjunction with education it accounts for about a quarter of the measured economies of scale which can be explained. However, it is not clear whether farm size growth would be associated with increasing concentration of production or whether small and large farms would tend to grow at the same rate. The key element in structural change in agricultural production may well be the human agent. Welch (1970a) and Huffman have provided empirical evidence on the importance of education in determining responses to technical innovation and economic change. The characteristics of farm operators are likely as well to be an important determinant of responses to change in the policy environment. In this context, the structural consequences of policy operate by influencing the demand for human capital. Equally important, from this point of view, are policies that influence the supply of human capital in agriculture. It could be that the most important governmentally directed influence on the structure of agriculture is the number and quality of graduates from land-grant colleges who enter farming. In the absence of government programs and policy intervention, there would be a demand for skills in dealing with uncertainty and disequilibria (see Schultz). In the presence of the complex set of policy interventions outlined above, the same type of demand exists. The factor limiting structural change in either case could well be the supply of these skills.

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[4] The figures in this paragraph are derived from data in the *Census of Agriculture*, and the USDA publications, *Agricultural Statistics* and *Farm Real Estate Developments*.

In sum, while there appears to be no doubt that technical progress and its diffusion has changed the structure of agricultural production toward larger-scale farming, it is not clear that the marginal contribution of public research and extension has been to accelerate or decelerate the rate of change to larger units, or the movement to increased concentration of production.

Allocation of Publicly Owned or Subsidized Resources

Governments at all levels from time to time sell or rent resources and services, sometimes at market prices but more often at subsidized rates. Transactions at market prices, unless in very large quantities, should have no particular structural consequences;[5] they are merely an exchange of value for value, and by themselves would not be expected to influence resource allocation, scale, or concentration of farming. Subsidized transactions confer increased wealth on the recipient in the private sector, but the wealth increase would not in and of itself be expected to have a strong influence on structure. The structural effects arise because there always tends to be an excess of willing takers of subsized resources and services, so that some form of nonprice rationing must be imposed by the government agency in charge. Whenever the rationing scheme has been based upon structural considerations such as size of operation, it seems without exception to have been intended to favor smaller operations as against large-scale farming or wealthy farmers. This approach has been followed in policies ranging from the Homestead Act to the Farm Security Administration (see Maddox, and Quance and Tweeten) to the upper limits on deficiency payments in current commodity programs to the 160-acre limitation on an individual's use of some federally-subsidized irrigation water. While such programs undoubtedly have targeted wealth gains to some smaller operators, it is not clear that they have seriously hindered structural change toward large-scale operations. The basic reason is that if resources can be combined more efficiently in large units of production, then it will tend to be the case that a small operator who receives a subsidized resource will do better financially to rent or sell the capitalized value of the subsidy rather than use it in a small operation of his own. Be this as it may, there are no grounds for concluding that public policy in this area actually has fostered structural changes toward large-scale farming.

Credit and Insurance Programs

Credit and insurance programs may have more pronounced structural effects because benefits are tied to particular operators and cannot be transferred so easily through a secondary market. The benefits are lower interest rates or insurance premiums, acceptance of riskier loans, and insurance of riskier projects than the private sector could or would undertake.

These programs should encourage more highly leveraged, more specialized, and larger enterprises for the same reasons mentioned with respect to price stabilization programs. Indeed, because price and output risks tend to be offsetting to some degree, the joint provision of price stabilization and production insurance may be more effective in encouraging highly leveraged operations than either type of program alone. The Food and Agriculture Act of 1977 provides joint coverage by means of deficiency payments and the disaster payment program. The issue again arises, however, as to what would happen in the absence of credit and insurance programs. It seems plausible that movement toward contractual arrangement of the sort discussed above, which result in loss of operator control over farming, would be encouraged if these programs were not available.

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[5] For large-scale public works projects like dams the same difficulty arises as for research, discussed above. There is an offsetting effect in that if there were not public investment, the number of large irrigation projects would be reduced. Thus, if irrigation projects contributed to economies of scale, even unsubsidized public investment has structural consequences.

Summary and Conclusions

Hypotheses about both structure and control as influenced by policy are abundant. Hard evidence, and even strong a priori reasons to expect particular hypotheses to be correct, are scarce. This paper does not remedy this lack, but it does bring in some arguments and data to cast doubt on views about policy and structure that have been advanced. The main general finding is that analysts of determinants and consequences of structure tend, to a degree even greater than in other areas of economic analysis, to make stronger claims than the available evidence warrants. The most that can be said is, compared to policies which have actually been applied, policies could be devised, and have been proposed, which would slow down the rate of structural change toward more concentrated agricultural production. But, as compared to the policy environment prior to, or most likely in the absence of, governmental institutions that now exist, historical policies have probably tended to retard the rate of structural change.

With respect to control, one problem is the nebulous usage of the term in discussions about control of agriculture. This paper considered three aspects of control: control over market price and quantity, political control over commodity policy, and control of decision making and resource use in farm operations. With the possible exception of marketing orders and cooperatives for some commodities, policy-induced market control seems to be a nonissue. Political control has probably been a source of policy-induced inertia in structural change and has provided indirect market power for farmers acting collectively. Control over decision making undoubtedly has shifted dramatically for some commodities, but virtually nothing is known of the role of policy in fostering or hindering these changes.

The current state of affairs, in sum, is that agricultural economists have not been able convincingly to establish a connection one way or the other between policy and the structure of agricultural production or between policy and control.

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Public Policy and the Control of Agricultural Production: Discussion

Neil E. Harl

Given the present state of the art on inquiry into the determinants of the structure and control of agriculture, it is not unreasonable to accept Gardner's conclusion that "agricultural economists have not been able convincingly to establish a connection one way or the other between policy and the structure of agricultural production, or between policy and control."

All but the most naive researcher, however, would concede that inability to establish a connection does not prove its absence. The more interesting and pragmatic question at present is whether proposed and recently implemented changes in policy would be expected to have an effect on structure and control, viewed prospectively. Within the past decade, the United States Congress and several state legislatures have indicated a willingness to legislate with respect to the structure and control of agriculture (Harl 1978), even though the effects were far from clear. In that time, it is arguable that more deliberate efforts have been made, legislatively and otherwise, to influence the structure and control of agriculture than in any comparable period of history. Some of these policy measures have not been in place long enough to produce an observable effect on structure and control.

In terms of a basic research approach to the problem, it may be productive to focus attention on variables expected to be associated with structure and control such as (*a*) absolute and relative changes in wealth per capita in the agricultural sector, (*b*) absolute and relative profitability of farm firms, including off-farm employment opportunities, (*c*) absolute and relative changes in the distribution of wealth, (*d*) the nature and rate of technological change, and (*e*) expectations as to the long-term dimensions of income, wealth, and technology rather than to focus attention singularly on evidence of direct linkages among "policy," "structure," and "control."

Definitions Needed

It would have been helpful had Gardner's paper provided a clear definition of "structure" and, to a lesser extent, of "control." Although the term "structure" is used frequently, it is not always clear what is meant thereby. The term has been used variously to encompass resource and firm ownership by farmers and nonfarmers; the source of management inputs, whether farm or nonfarm; the average size of firm and size distribution of firms; and the organizational structure of firms and those leasing assets, particularly land, to farm firms.

Estate Tax Policy

Examining first Gardner's comments under the rubric of federal estate tax policy, on the way to concluding that "neither the theoretical basis nor the empirical evidence to estimate the structural consequences of our tax laws exists at present," he makes several points worthy of comment.

First, he asserts that federal estate tax rates for a taxable estate of $500,000 have risen, which is untrue in either absolute or real terms. Gardner states that the federal estate tax rate on a $500,000 estate was 29.5% "under prior law" and is 31.2% under "the 1976 Act." In fact, the pre-1977 average federal tax rate on a taxable estate of $500,000 was 26.66% after taking into account the credit for state inheritance tax paid (effective in all states except Nevada) or 29.14% without the credit. More important, the average federal estate tax rate on a taxable estate of $500,000 for deaths after 1976 is 19.76% after all credits are taken into account.

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The unified credit is notable in its own right for its expected impact on wealth distribution and perhaps, ultimately, on the structure of the sector and control of its firms. In the face of determined lobbying efforts to increase the $60,000 federal estate tax exemption to $200,000 or more, the Congress eliminated the exemption and substituted the unified credit. Unlike the exemption, which is worth the greatest dollar amount to those in the highest federal estate tax bracket, the credit carries the same dollar benefit to a taxpayer regardless of size of estate—assuming the calculated tax equals or exceeds the allowable credit (Harl 1976).

Gardner mentions "deferred payment of tax bills" along with "use" value of land as "offsetting" the "increased" federal estate tax rates. Indeed they do. Under 15-year installment payment of federal estate tax, with its 4% interest on up to $345,800 of federal estate tax (less the unified credit) attributable to a closely held business, the economic benefit relates heavily to the net return expected on deferred tax dollars. At a 5% net rate of return, compounded earnings reach 14.4% of the tax bill over the payment period (which is actually fourteen years and nine months after death). At a 10% net rate of return, the compounded earnings pay all the tax and more than 80% of the interest. With such benefits flowing from the deferred-payment provision because of the time value of money, substantial incentives are generated to qualify property for the election (Harl and Boehlje). Two notable requirements are that the assets must be in a "business" immediately prior to death, and postdeath disposition of more than one-third of the assets causes termination of tax deferral. It seems reasonable to hypothesize that postdeath sale of property will be inhibited, continuation of firms encouraged, and sale of farm business assets for fifteen years after death discouraged.

Two other provisions bear mention in the same general context. Gardner acknowledges "use" valuation of farmland as influencing the effective federal estate tax rate. For 1977 and 1978, "use" value generally has ranged from 35% to 50% of fair market value, with the greatest reductions apparently accruing to the more highly valued land (Boehlje and Harl). For those with sizeable estates, the motivations from the prospect of "use" valuation may be significant. Land tends to be worth relatively more to those who can meet the eligibility requirements. An individual farmer may be encouraged to tilt toward more investment in land and less in nonland with advancing age. Over time, the valuation procedure may tend to encourage nonfarmers to try to be involved actively in management, one requirement of eligibility, and to make it easier for farmers to bid land away from nonfarmers.

Table 1 shows the per-acre price premium that could be paid for real property that would qualify for "use" valuation. For a purchaser with a life expectancy of five years (the minimum holding period for eligibility) the price premium that could be paid is about 12% of the fair market value of the land used in the analysis. Those with a longer life expectancy would pay a lesser premium for the benefits of "use" valuation as the potential benefits are discounted to present value. Investment behavior to increase purchases of land would be expected to the extent that the individual's investment in land would not produce the maximum reduction of federal gross estate of $500,000.

Avoidance of sale of land for fifteen years after death except within the family is necessary to prevent recapture of tax benefits.

Income Tax Policy

Two recent major changes in income tax policy are expected to have substantial impacts

Table 1. Value of Benefits From "Use" Valuation Per Acre of Land

		Present Value of Benefits (8%) Assuming Death in:			
Net Worth	Benefits Per Acre	5 Years	10 Years	15 Years	20 Years
		$			
500,000	252	172	117	79	54
750,000	267	182	124	84	57
1,000,000	261	178	121	82	56

Source: Boehlje and Harl.

on income and wealth distribution and investment behavior, neither of which is mentioned by Gardner.

In 1975, at a time when several states were attempting to limit the use of the corporate form of organization in agriculture, the United States Congress reduced sharply the federal income tax rate for corporations. Before 1975, corporate federal income tax rates were 22% of the first $25,000 of corporate taxable income and 48% on all above $25,000. In 1975, corporate federal income tax rates were reduced to 20% of the first $25,000 of corporate taxable income, 22% on corporate taxable income from $25,000 to $50,000, and 48% on corporate taxable income above $50,000. For a corporation with at least $50,000 of corporate taxable income, the federal income tax was reduced by $7,000, or by 40% of the pre-1975 rate. The expected result is a substantial motivation to utilize the corporate form of organization.

The creation of a new taxpaying entity paying tax at an average federal income tax rate of 21% on the first $50,000 of taxable income requires modification of conventional thought with respect to the graduated rate character of the income tax system.[1] However, as pointed out elsewhere (Harl 1970, 1978), attacking the problem of the changing structure of agriculture by prohibiting specific forms of business organization is almost certain to be doomed because of the imperfect correlation between structural characteristics of firms and method of business organization and because of availability of alternatives.

The second recent major change in income tax policy with a potential for affecting structure (and control) is the carryover basis concept, effective in 1977 (Harl and Boehlje). For deaths before 1977, property included in the federal estate tax gross estate received a new income tax basis equal to the value placed on the property for federal estate tax purposes. For carryover basis property, which includes most farm property, death after 1976 does not create a new income tax basis. Rather, the gain is "linearized" over the holding period for the property, with gain representing the period before 1977 eliminated at death.

The short-run effects, from a policy point of view, involve mainly income and wealth distribution considerations as farm inventory property, nearly all of which is gain, is sold after death. In the long term, if the trend is toward an increase in the general price level, including the price of land, the potential income tax liability per unit of land would likewise increase over time unless the property was sold (Harl and Boehlje). Sale would be expected to become less likely as the net sale value (after payment of income tax liability) diminishes relative to fair market value. In effect, income tax liability could become a factor inhibiting sale, with the result of "locking land into families." With each generation, *ceteris paribus,* the probability of taxable transfer of such assets would be expected to diminish.

Other Dimensions

Although time and space do not permit detailed consideration here of other dimensions of policy and structure/control, students of structure and control in agriculture should find Emerson's forthcoming review and analysis to be very helpful. He takes the position that "though the structure of agriculture is determined by a number of factors, public policy is one of the most important" (p. viii). Work demonstrating the relationships between price-support programs and land values is supportive of that point of view (Boxley and Gibson, Harris, Mayer, Reynolds and Timmons) under the assumption that land values relate to structure and control.

Conclusion

In recent years, an unprecedented series of modifications in the decision-making framework for farm firms and investors in farm assets has elevated the policy-structure-control nexus to a new level. However, in congressional efforts to "come to the aid" of farms (and other small businesses), relatively little attention has been given to whether such efforts are likely to further an objective of a sector of relatively small, family-held firms. Encouraging the continuation of farm firms beyond the generation of their creation may not be completely compatible with such an objective.

As a result of recent changes in tax policy, motivations for sale of agricultural resources, particularly land, will be reduced. The creation within agriculture of a "landed aristocracy" is more than idle speculation (Mayer, Woods and Sisson).

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[1] H.R. 13511 would reduce federal corporate income tax rates to 17% on the first $25,000 of corporate taxable income, 20% on the second $25,000, 30% on the third $25,000, 40% on the fourth $25,000, and 46% for amounts above $100,000. For a corporation with taxable income of $100,000, the proposed rates would reduce the tax bill by 22.5% compared with 1978 rates.

As noted a decade ago (Harl 1970), the greatest enemy of the small farmer is the well-managed, well-financed neighbor down the road. Recent changes in the tax system are designed to make economic life easier for the larger family farm operator, with a possibility of accelerating the trend toward larger units.

Moreover, the relevant policy objective function may not admit of a single element as the proponents of a particular structural configuration for the agricultural sector may have in mind. On other days, in other settings, the objective function may also include a food policy objective and, more specifically, a least-cost food policy both to consumers and to the U.S. Treasury. In this post-Proposition 13 Era, the latter element may assume even greater prominence than in the past.

It will be some years before the net effect of the recent changes can be identified and quantified. Moreover, it is possible that other factors may neutralize the effects of recent policy changes, with no resultant observable impact on structure and control. It is hoped, however, that Gardner's point about the inability of agricultural economists to establish connections between policy and sectoral structure and policy and control will not discourage agricultural economists from (*a*) continuing to examine these relationships for cause-and-effect relationships and (*b*) even more important, providing advice and counsel to policy makers as to expected effects of proposed policy changes, including effects on structure and control, hopefully in a general equilibrium setting.

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The Control of Agricultural Processing and Distribution

Willard F. Mueller

This paper examines the sources and consequences of control in food processing and distribution and offers some recommendations for public policy. By control I shall mean power over decisions—economic, political, and social. The ability to control derives from the environment in which the controllers function.

Industrial organization theory provides the framework for examining the interrelationships between the economic environment and the controllers, positing that certain characteristics of a market's structure determine the extent of control possessed by participants in the market. But market participants' behavior is also influenced by myriad and complex legal rules reflective of the social and political environment.

In our model, the participants do not respond passively to their environment. Rather, they actively try to shape (control) economic and noneconomic institutions to their own advantage and aggrandize their power, wealth, and prestige. Industrial organization theory, broadly defined, explains how those in power use their control over markets to reap benefits in the marketplace. Unfortunately, it has less to say about how the fruits of power may in turn be used to restructure markets and change institutions so as to achieve additional power or prevent erosion of existing power.

In food processing and distribution the main participants (controllers) are a few hundred corporations that, implicitly, have been granted the privilege, though not an explicit responsibility, of running this industrial sector in the manner of huge corporations elsewhere in the economy. Longtime ITT board chairman, Harold Geneen, acknowledges baldly these realities: "Increasingly, the larger corporations have become the primary custodians of making our entire system work" (Sampson, p. 125). This heavy dependence on huge corporations quite naturally raises questions about the legitimacy of their custodianship, of whether they are running the system in the public interest. Resolving this issue frequently leads to a clash between the corporation and democratic institutions. Since the main threat to private power not disciplined by market forces is the state, corporate power may seek to subvert, neutralize, or co-opt the state, making it an ally rather than a foe in the struggle for control.

Thus, inquiry into questions of control inevitably leads to questions of public policy; indeed, this is the major reason independent researchers need make inquiry into the matter. In order to contribute meaningfully to the public policy dialogue, it is necessary to understand the sources, nature, and consequences of corporate control. Determining the legitimacy of these consequences brings us to the area of performance norms, a subject to which I shall return. But first I shall examine briefly the economic sources of control, namely the structures of modern markets and the forces changing them.

Market Structure

Industrial organization theory defines market structure sufficiently broadly to admit examination of any market characteristic that has a significant influence on market behavior. In practice, however, three characteristics are singled out for special attention: the number and size distribution of firms, the condition of entry, and the degree of product differentiation. These variables receive special attention because economic theory suggests they are particularly relevant in explaining behavior and partly because these are the only variables for which data are available across many industries. And, of this trinity of variables, data are most readily available and reliable for

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market concentration, a proxy for the number and size distribution of firms. The considerable attention given to examining concentration has led some to characterize industrial organization as being preoccupied with a "numbers game." While the criticism has some justification, it misses the point that not only does market concentration have a sound theoretical basis in its own right, but its significance is heightened as an index of changing power relationships because it is correlated with other structural indices, especially barriers to entry and product differentiation.

Connor shows that not only are the food industries on average more concentrated than other industries, but that there is an upward trend in concentration (p. 17). This overall trend, however, conceals more than it reveals because of the contrasting patterns among industries. Concentration patterns in food are similar to those in all manufacturing industries, where average concentration is stable or declining in producer products and increasing in consumer products. The latter increases are both substantial and persistent in those industries where advertising is most important (Mueller and Rogers).

The structure of grocery retailing also is experiencing rising concentration, both nationally and locally. The trend seems to have accelerated in recent years despite the virtual completion of the conversion from small stores to supermarkets, a growth in the number of viable medium-size chains, and the decline of the industry's long-time leader, A&P. The most significant change—for issues of potential control—is the increase in the number of highly concentrated markets. Whereas in 1954 the top four corporate chains made 60% or more of the sales in only 5% of 194 metropolitan markets (SMSAs), by 1972 this level of concentration existed in 25% of these markets (Marion et al., p. 18). Moreover, these trends accelerated since 1972. This is important because empirical studies have demonstrated that when four firms make 50% to 60% of a market's sales they achieve substantial control (Weiss). Nor is food retailing an exception to this near universal finding (Marion et al., p. 3).

The preceding indicates that judged by traditional indices of industrial organization, the degree of corporate control over food processing and distribution has risen throughout the post-World War II years. But market concentration is only one source of market control. Another source, and a generally neglected one, is conglomerate-derived power. Whereas oligopoly theory explains power derived from the characteristics of a particular market, conglomerate power derives from the internal characteristics of firms, in particular their participation in many industries, which enables them to pursue a variety of competitive strategies in the many diverse markets in which they operate. These strategies include cross-subsidization in pricing or marketing, reciprocal trading involving separate treaties that short-circuit market exchange with customers and suppliers, and forbearance in competing with actual or potential competitors (Mueller 1977). These dimensions of power differ from those arising from oligopoly, which promote shared control over market relationships with customers and suppliers. In contrast, conglomerate power most often is used to restructure markets and thereby to reinforce or augment the power conferred by oligopoly. Time does not permit elaboration of the theory of conglomerate power, though I remain persuaded that firm conglomeration remains a much neglected structural variable in industrial organization research in the food sector (Mueller 1969).

Although many may view these characterizations as unfounded speculation, the facts of conglomeration are becoming so impressive that even skeptics can no longer ignore them. Although there long have been some multimarket corporations in the food industry, today such firms are the rule, not the exception. Connor estimates that 200 corporations control about 63.5% of all food and tobacco processing sales (p. 62). All these corporations are conglomerates. The most conglomerated of these is Beatrice Foods, which operated in at least 40 grocery and 37 nonfood industries (as measured by 4-digit SIC industries) in 1975.

Large food retailers also qualify as conglomerate enterprise because they operate across many geographic markets as well as engage in manufacturing some of their own products, assume the branding function for many more and, increasingly, are parts of large nonfood chain enterprises (Marion et al.). This multimarket presence in food retailing carries the same potential for conglomerate power as the multiproduct operations of food manufacturers.

Causes of Changing Structure

Market concentration in food and other manufacturing industries has been propelled only in part by plant and multiplant economies of scale. While technological imperatives have caused increased concentration in some industries, examination of concentration changes between 1947 and 1972 reveal a surprising pattern. The average level of concentration in manufacturing industries has remained remarkably stable over the period. Indeed, it has shown some tendency to erode in producer product industries, where technological and capital requirements of scale are most important. In contrast, average concentration has risen in consumer product industries, which encompass practically all food-processing industries. Mueller and Rogers found that while changes in scale economies played some role in this process, the prime force for increasing concentration is found in factors related to advertising-achieved product differentiation. The uniqueness of this study is the finding that television advertising played a central role in growing market concentration in consumer product industries.

This supports the hypothesis that the introduction of commercial TV advertising after World War II created a disequilibrium in the structure of markets lending themselves to image-building advertising. The disequilibrium resulted because there are substantial real and pecuniary economies of scale in TV advertising. Though the pecuniary economies were greatest and most blatant until the late 1960s, when maximum rate discounts for network TV reached 60%, they continue today in more subtle forms. But the structural disturbances caused by advertising go beyond those arising from real and pecuniary advantages of scale. There is compelling evidence that large conglomerate firms often engage in what amounts to predatory marketing strategies, current examples of which are the expansion tactics of Procter & Gamble (P&G) in coffee and Philip Morris in beer.

Following the acquisition of the Folger Company in 1963, and an antitrust settlement in 1965 that permitted P&G to keep the Folger brand, P&G has pursued an aggressive expansionary policy (Mueller 1978, pp. 87–91). In its quest for greater market control, P&G marched eastward from Folger's traditional strong western markets. Following a well-planned itinerary, P&G swept eastward from city to city until today it is besieging the huge New York City market. In its march to the sea, it used a variety of marketing techniques including price discounts, heavy TV advertising, and couponing. The P&G example illustrates the special structural impact when two conglomerates become locked in a struggle for preeminence. General Foods, long the leader in the coffee industry, was unwilling to yield the field to P&G without giving battle. In the ensuing struggle, many smaller, single-line coffee companies became casualties, with even third place Hills Brothers losing almost one-half its market share. Although P&G apparently is encountering especially severe resistance in General Foods' stronghold in New York, the structure of the industry is being drastically altered. P&G's losses of $60 million on its Folger coffee operations in fiscal 1977 attest to its ability and willingness to forego enormous short-term losses to gain long-term market control.

The application of conglomerate power to restructure the beer industry is even more dramatic. This is a matter on which I acknowledge a personal interest. I first became interested in developments in the beer industry two years ago when a law firm representing a leading regional brewery asked me to analyze the probable competitive effects of the Philip Morris-Miller merger in 1970. However, the views expressed here are my own (Mueller 1978b).

Following Philip Morris' acquisition of Miller Brewing in 1970, Philip Morris used its huge multinational resources to launch a massive program of subsidized advertising and brewery plant expansion. Miller rose from eighth to second place in six years, an unparalleled accomplishment in this industry, as it pursued a publicly proclaimed policy of becoming number one. The result has been an unprecedented increase in market concentration, as the top five companies' share rose from 49% in 1970 to 73% in 1978. Evidence of Philip Morris' power is that even the leading regional and national brewers are having difficulty competing with Philip Morris. Anheuser-Busch (A-B) was the only leading brewer other than Philip Morris-Miller to gain market share in 1977, and even A-B's share remained below the share it held prior to the prolonged strike it experienced in 1976. Developments in brewing lay bare the unique and awesome power of the conglomerate enterprise competing with specialized firms whose livelihood depends entirely on a single-line of business.

The impact on industrial structure of conglomerate power in grocery product manufacturing is duplicated in grocery store retailing. When retailers operate across a number of metropolitan markets, their behavior is not constrained by the structure of any one market. They may employ strategies not available to smaller, less diversified firms, a freedom enjoyed to varying degrees by all large retailers (Marion et al.). Again, the effects of cross-subsidization are most devastating for single-market firms caught in the middle when large conglomerates battle over market shares. Our empirical analysis reveals that as the presence of conglomerates in a local market increases, sales concentration among the top few firms also tends to increase. More surprising, however, is the finding that concentration increases when conglomerate grocery retailers or large nongrocery retail firms enter a new market, whether by acquisition or *de novo*. This may surprise some persons who believe *de novo* entry always erodes concentration. But our finding requires qualification because the sample of *de novo* entrants was heavily weighted to less concentrated markets. The analysis therefore does not tell us the effects of *de novo* entry in highly concentrated markets.

Strategies aimed at increasing market share will be attractive if foregone profits today can change the market environment sufficiently to enhance profits tomorrow. Increasingly, large corporations appear to be pursuing such strategies, taking their clue from the teachings of the Harvard Business School and others. Buzzell et al. recently reported: "An ongoing study of 57 companies reveals a link between ROI and market share—the bigger the better" (p. 2). This finding is hardly new. An FTC study of food manufacturing firms in 1950 found a strong positive relationship between a firm's relative market share and its profit rates. Imel, Behr, and Helmberger found a similar relationship for the early 1960s, and an unpublished study by the NC-117 research core group found a similar relationship for the late 1960s. Marion et al. also found that the relative market share held by a large retail food chain in a metropolitan market is positively correlated with both its profit rates and relative prices.

These research findings are of more than academic interest. Bloom and Kotler discuss strategies to achieve increased market share. Business consulting firms, such as the Boston Consulting Group and Mitchell Hutchins, actively advise businessmen to pursue market-enhancing strategies. Listen to the sort of advice Mitchell Hutchins gives its clients:

> The goal of investment strategy should be to prevent rivals from obtaining a sufficient share to achieve a competitive ROI, to place competitors in a long-run cash-trap position, and to discourage investment. . . . Pricing strategies can take numerous forms: price cuts . . . , advertising and promotion . . . , innovative new-product introductions . . . , store sites, dealer systems and credit arrangements . . . , service and marketing organizations, *or any other mechanism that increases the cost of effective competition*. . . . When an important market position (a minimum 25% of the leader's position) cannot be obtained, cashing out becomes an appropriate strategy. (Emphasis added.)

Though this advice is not necessarily new, it does appear that more large food processors and retailers are pursuing systematically such market share strategies today than in the past. Perhaps this reflects greater managerial sophistication; but more likely it reflects the greater capacity and flexibility large conglomerates possess to pursue such objectives. Herein lies a connecting link between increased conglomeration and increased market concentration.

The Extent and Use of Control

We now turn to the question of just how much economic power is possessed by the corporate controllers in food manufacturing and distribution. The common adage, wealth is power, has meaning in the business world as well as in the affairs of men. Not only are profits the fruits of power but the seeds of additional power. When corporations achieve supranormal profits, they gain a degree of immunity from financial markets, a not insubstantial advantage. They also have discretion in how they use their profits. Profits may be used to pay higher salaries and wages, reinvested at expected long-run returns below those that financial markets would condone, invested in short-run cross-subsidization strategies aimed at enhancing market share, etc. Thus, one reason for studying the relative profitability of corporations is that profits provide a means for achieving greater control over the system. This interest differs from the traditional concern of economists with excess profits as a measure of welfare loss and income redistribution.

The preceding section showed how the huge conglomerate corporation can deploy its resources to restructure markets. I include this as an important dimension of performance because it distorts the "natural" evolution of market structures by resulting in the survival of the most powerful rather than the most efficient. By this standard, much conduct of huge firms must be judged as resulting in socially undesirable performance.

Some segments of the food system also appear to be causing waste and worsening income distribution. Recent studies have estimated the size of monopoly overcharges (which measure both allocative efficiency and distributive effects of monopoly) in food distribution and manufacturing. Marion et al. concluded that the existence of market power in many metropolitan markets resulted in monopoly overcharges of $662 million in food retailing in 1974 (p. 80), an estimate that may understate total overcharges since it covers only the four largest retailers in SMSAs covering about 73% of total grocery store sales.

The monopoly overcharges for food manufacturing appear even greater than those for food retailing. Using three alternative procedures, Connor and Parker estimate monopoly overcharges of over $10 billion, or over 6% of food manufacturing sales in 1975. Doubtless some will be skeptical of these estimates, especially those who were "shocked" by the monopoly overcharge estimates of under 1% of sales in food retailing.

The above suggests the consequences of private control over the food manufacturing and distribution system, consequences that affect both farmers and consumers, as well as other less powerful actors in the system. But some may still defend the performance of those food manufacturers with great power on grounds that excess profits are necessary for, or the result of, their innovative behavior in developing new products that lessen the homemaker's burden. While not demeaning all such efforts, it seems to me that the main thrust of these efforts involves image-building advertising and the creation of new market segments, the net result of which frequently is to persuade consumers to pay more for the same, and sometimes more for less. Philip Morris-Miller's introduction of its Lite brand is the ultimate triumph of advertising-created product differentiation, allowing a product that costs less to produce to be sold at a premium price. The Lite story is only a play within a larger play, the consistent theme of which is to persuade consumers to live in worlds of illusion and to switch up to premium and superpremium beer brands. I estimate that the leading brewers' success in increasing the share of premium and superpremium beers from about 30% of the market in 1970 to 60% in 1978 will cost beer drinkers $400 million in 1978. This is a conservative estimate, because I used the price of Pabst (the premium of the nonpremium beers) to estimate the cost of the increased share of consumption going to premium and superpremium beers. There is no evidence that consumers can detect in blind tests real taste differences among beers. Significantly, in an FTC investigation of the industry in the early 1970s, the leading brewers steadfastly resisted data requests for consumer taste tests. Scherer, who was the FTC's chief economist at the time, infers from this resistance that the brewers' own studies would have shown that "American consumers pay their premium price mainly for the label rather than for the quality of the contents" (Scherer, pp. 997–98).

Some may still insist, I suspect, that consumers are nonetheless better off because they think they are better off. This is the kind of silly reasoning that gives "sophisticated" economics a bad name among people of common sense. Let us be done with such rationalization. The prices consumers pay in these circumstances are determined by the market power of sellers, rooted in large part in consumer ignorance and confusion created by advertising. Merely because a consumer is willing to pay more for a light (lower calorie) beer is no reason he should pay more if it costs less. Many Americans prefer "2%" or "skim" milk to ordinary whole milk. And doubtless many consumers would be willing to pay more for the lower cost fluid milk products. The reason they need not pay more is that competition forces prices to reflect cost differences. This is the way prices are expected to function in a market where competition is working properly.

Time prevents examination of other dimensions of performance, e.g., technological progressiveness, which I judge to be quite good in food manufacturing. Suffice it to say that food corporations have a great deal of control over the food system, and that if present trends continue, this control will increase. This raises the question of whether there are public policy options available to deal with existing control and the prevention of greater control in the future.

Public Policy Initiatives

There was a time when I disagreed sharply with John Kenneth Galbraith's views of the antitrust laws (Mueller 1967). But experience has converted me to Galbraith's view that much antitrust is, indeed, a "charade." By promising more than they can deliver, antitrusters mislead the public into believing economic power is being policed successfully. Thus, a deluded public has come to believe that some industries are becoming more concentrated because the big are always the best and that the small are always the least efficient.

But having acknowledged my disenchantment with much antitrust, I still cannot embrace Galbraith's prescription that we concede the failure of the antitrust laws and "allow them quietly to atrophy." Galbraith urged this course in the expectation that having done so, "then we would face the real problem which is how to live with the vast organizations—and the values they impose—that we have and will continue to have" (Galbraith 1967, p. 11).

Professor Galbraith's recommendation that we permit the antitrust laws to atrophy assumes that they will be replaced with more effective instruments of social control. But what are these new instruments of social control and who are their champions? I am not at all confident that those who control "these vast organizations" will permit Galbraith's bright new day to dawn. No, until an alternative is found, we must retain and strengthen our antitrust laws and enforce them with greater vigor, not less, while recognizing that they must be supplemented by other forms of social control. I am gratified that Galbraith recently recanted at least some of his earlier views on antitrust, and now is especially critical of conglomerate mergers (Galbraith 1978).

Time permits only a brief summary of steps that might be taken to cope with the growing centralization of corporate power and its consequences. The antitrust alternatives include restraints on conduct and industrial restructuring.

The following are types of conduct that deserve special attention:

(*a*) Selective anticompetitive geographic price discrimination in both food retailing and food manufacturing.

(*b*) Preemption of preferred television time by the leading firms in an industry.

(*c*) Massive advertising to deter entry in food retailing.

(*d*) Restrictive leases that preempt choice store location in food retailing.

(*e*) Massive subsidized television and related advertising and promotion by huge conglomerate food manufacturers when bringing out new products or expanding sales of existing brands.

(*f*) Acquisitions and mergers that eliminate actual and potential competition or which entrench an established firm.

Each of the above types of conduct can be challenged under the antitrust laws, although the efforts have been quite ineffective in recent years.

Structural problems requiring attention include:

(*a*) shared monopoly both in some food retailing markets and food manufacturing industries;

(*b*) increasing industrial conglomeration;

(*c*) advertising-created barriers to entry.

Although these structural problems may be reached by existing law, new legislation would expedite relief. Excessive concentration in some local grocery store markets could be challenged as shared monopolies under the Sherman Act, an alternative that the Justice Department reportedly is considering at the present time. The Canadian government has attacked the problem by placing a limit on the growth of the dominant chain in a market for a limited period of time (Hearings, p. 27).

The problem of increasing conglomerate power can be dealt with partially by more aggressive antimerger enforcement under existing law, although new legislation is needed here as well. Although such actions would only slow growing conglomeration, they would be a significant accomplishment since they would discourage the kind of drastic restructuring currently occurring in some manufacturing industries and some grocery retail markets.

Additional means of controlling conglomerate power include greater public disclosure of the operations of huge conglomerate corporations. The recent Supreme Court decision in

First National Bank of Boston v. Bellotti (98 S. Ct. 1407 [1978]) permits corporations to use their funds to influence matters having nothing to do with "the property, business or assets of the corporation." This is merely the last link in a chain of decisions beginning in 1886, granting the corporation the same rights as a person with respect to property. Arthur S. Miller, a leading constitutional scholar, reasons that this decision has set the stage for "the Justices to take another mutational leap—to 'constitutionalize' the corporation once and for all, and thus to ensure that those artificial persons accord fundamental fairness and decency to all whom they touch and concern" (p. 8). I fear the current Supreme Court will not take this "leap." I therefore prefer the more direct approach, though perhaps one equally unlikely to succeed, of enacting legislation requiring federal chartering of large corporations (Mueller 1973).

Finally, there is the matter of what to do about power originating in advertising-created product differentiation. This is both the most persistent and the most difficult problem to deal with. But steps can be taken, and the first steps have. Since the main problem derives from the distorting impact of advertising on consumer choice, the solution to the problem must begin here. A series of initiatives aimed at this problem were taken over the last fifteen years including: (*a*) affirmative disclosure requirements, (*b*) corrective advertising, (*c*) substantiation of advertising claims, (*d*) counter-advertising, and (*e*) greater consumer education in the high schools and elsewhere. More direct initiatives also are needed including greater application of the antitrust laws to advertising strategies that injure competition.

Many more items could be added to the list of needed initiatives. But our inability to fashion appropriate means of social control of private power does not stem from a lack of ideas. The problem lies in a social-political climate highly resistant to reform. As I noted at the outset, those possessing economic power seek out ways to influence the political environment to protect and, where possible to enhance their privileged position. Never in my career have huge corporations exercised such great power over the political environment as they do today. In his insightful examination of the modern corporation's place in a democratic society, the political-economist, Charles E. Lindblom, ends on a discouraging note. Many will be troubled with his conclusions while finding it difficult to reject them:

> . . . Enormously large, rich in resources, the big corporations . . . can, over a broad range, insist that government meet their demands, even if these demands run counter to those of citizens. . . . Moreover, they do not disqualify themselves from playing the partisan role of a citizen—for the corporation is legally a person. . . . They are on all these counts disproportionately powerful. The large corporation fits oddly into democratic theory and vision. Indeed, it does not fit. (p. 356)

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Public Policy and the Control of Agricultural Processing and Distribution: Discussion

R. J. Herder

I share Mueller's concern over the potential antisocial impact of concentrated economic power. And there is no denying that "food corporations have a great deal of control over the food system, and that if present trends continue this control will increase." Perhaps he is correct in asserting that one result has been antisocial behavior on the part of food corporations. The limited usefulness of industrial organization theory, however, provides rather weak support for general conclusions with respect to behavior or for public policy prescriptions. Either a restructuring of Mueller's model to include a broader selection of variables or a simple empirical survey of the food industry turns up many significant departures from the general results he has attempted to establish. Thus, while I certainly would not argue against the updating and enforcement of existing antitrust laws, I do not find in the current organization of the food industry a compelling reason for a wholesale overhaul of antitrust laws, much less a need to initiate a public debate over the role of "huge" corporations vis-a-vis democratic theory.

The application of industrial organization theory to any industry situation is a slippery task. The building of models from the theory leaves much to the imagination of the researchers. As Mueller says, the theory admits the examination of any market characteristic that has a significant influence over market behavior. I would prefer that the theory require the examination of all significant market characteristics plus some quantification of their relative significance. For instance, in the two examples, coffee and beer, heavy weight was given the financial resources of the firm and the size of promotional budgets in predicting marketing success. While those variables are undoubtedly important, one can wonder about their relative importance had the model also examined a broader grouping of variables, such as raw material prices, consumer demand patterns, management competence of competitive firms and existing competitive conditions. For both examples one could argue that the entry or expansion of a new large firm is more a threat to an existing, but not necessarily socially appropriate, competitive equilibrium than of long-run monopolization. In beer, the rise from eighth to second in an already concentrated industry may have a variety of explanations, only one of which is the size of the promotional budget of the successful firm. Further, there is no particular theoretical reason to believe that once one firm has achieved such success it necessarily precludes any other firm from doing the same thing.

The process of selecting significant market characteristics is symptomatic of a general problem with the theory. For example, even the term "market" is uncomfortably open to arbitrariness as it seems to allow definitions ranging from relative product prices, products, and consumers, to geographic area, and to use them interchangeably. Similarly, performance can be and is defined and measured in economic, social, or political terms. Certainly if the performance in the food industry is defined as financial results (a frequently used measure in micro economics) the industry is no big deal. The evidence of monopoly profits, whose short-term existence even in a perfectly competitive model should not be a surprise to an economist, suggests less than desirable economic performance, although the attraction of such a potential apparently is not lost on firms moving into new markets or activities. I am not aware of any quantitative measure of political performance, but from my view of food corporations, I am not overly impressed with their success.

The heavy reliance on concentration ratios, while admittedly a useful indicator, does make

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the theory a numbers game and judgment from the numbers tends to be subjective. For some reason I find an industry controlled by a few hundred corporations more reassuring than alarming, especially when I broaden the industry model to include cooperatives, private firms, and government. Anyway, what if it were only ninety-nine, or the magic number four? At what point do I begin to worry? In some markets, four might be too many. The numbers game also tends to mask the internal dynamics that exists in an industry. The most dramatic example is meat packing, where concentration probably has changed little over the years but where entirely new firms are now dominant. A firm or sector review of the food industry reveals an interesting pattern of entries and exits, stagnation, and growth at almost all levels of the industry.

I also find Mueller's description of the industry a bit too monolithic and unrestrained. One should not be surprised to find product differentiation and increasing market shares as important strategies in a slowly growing industry—or at least that should be one of the lessons learned from micro theory. However, to proclaim the intent to be number one and to achieve it are not the same. Competing firms tend to use maintenance of market shares as a countering strategy. Besides, firms can and do use a variety of profit-increasing strategies that do not necessarily mean market dominance or even increased market shares. In addition, some firms are more concerned with more mundane ends such as return on investment and increasing dividends than with market dominance per se.

No matter what strategy, a firm rarely is unconstrained in its decision making. Granted a corporation lives forever and that short-term profits can be sacrificed for the long-term market control. A manager lives in the short run, however, and it is probably not too good an idea to run a long string of short-term losses. The owners and debt holders of firms are not too sophisticated when it comes to understanding the long run and their patience is definitely a short-term span. After a while it is difficult to distinguish between short-term losses incurred for long-term market control and those due to inept management. As only a few firms can generate sufficient cash flows to finance normal capital replacement, much less ambitious expansion plans, the debt and equity markets act as real constraints on their actions.

Another constraint is management itself. While I am uncertain about the economic nature of the conglomerate, I suspect that an analysis of such firms would turn up something akin to diseconomies of scale. New management and information techniques probably have extended the range of activities that can be handled successfully, although conglomerate failures and the reoccurring devestment of activities by others suggest a definite limit to the profitable span of control. Some analysts argue that one of the largest and currently most successful of the food industry conglomerates is rapidly reaching that point.

Industrial organization theory also is of little help in the gray areas of economic trade-offs. The easiest example to take up is advertising, the classroom favorite. Much advertising is dumb, distasteful, and possibly immoral. Much advertising is informative and helpful to the consumer. Most probably falls in between. I find this area something of a dilemma. While I support attempts to clean up advertising according to my preferences, I am also all in favor of the move to get the sellers of professional services into the advertising game. I suppose my next worry will be high pressure ads for unnecessary legal and surgical services. Unfortunately, I find economic theory of little help in evaluating the mind-bending propensities of advertising or the irrational behavior of consumers or in making the necessary policy value judgments.

On a more fundamental basis and aside from the relationship among economies of scale, productivity gains and industry concentration, which I would tend to weigh heavily in policy prescription, limitations on firm size and market penetration could have other economic consequences. An obvious one is that while a small efficient firm might be protected, so would the less efficient and poorly managed. Also, and of perhaps greater importance in rural areas or small urban centers, restricted entry or expansion by large firms may simply preserve monopolistic positions, or, if I understand the concept correctly, locally shared monopolies.

Another trade-off relates to a possible relationship between government regulations and increased concentration. Here I am referring to the cost incidence of EPA- and OSHA-type regulations. To the extent that industry bears the cost, the smaller firms are the most vulnerable in terms of finance and management. Exemptions of small firms from an otherwise socially desirable regulation seems to me inappropriate and a system of discriminant subsidies might be hard to justify. In any event, this type of trade-off illustrates a possible cross-current in the public policy sphere.

Finally, and in conclusion, I am more optimistic than Mueller about social and political response to concentrated economic power. After all, antitrust laws themselves are a legislative response to a social movement. My reading of history finds a series of social movements, e.g., the Grangers, labor, and more recently environmentalist and consumerists, that have led to policy actions designed to counteract concentrated power. Nor has the food industry been neglected if we include public support of cooperatives, market orders and agreements, and pure food and grading laws as legislative acts in response to social action. While reform has seemed to come slowly and not without trauma, I am not quite ready to admit that the current public is lacking in social inventiveness or incapable of responding to social need.

Recent Policy Changes in Selected Countries
(Lowell S. Hardin, the Ford Foundation, Chairperson)

India—A Drive Towards Self-Sufficiency in Food Grains

J. S. Sarma

Achievement of self-sufficiency in food grains has been one of the principal objectives of economic development in India.[1] Though government-sponsored efforts for increasing production of food grains started under the Grow More Food Campaign in 1943, to meet the shortage of food caused by the stoppage of imports of rice from Burma, self-sufficiency as an objective of food production policy was announced for the first time towards the end of 1948. This objective was hoped to be achieved by March 1952.

Over the last three decades, India has imported nearly 120 million tons of cereals, the imports in a single year reaching as high as 10.36 million tons in 1966. While there were substantial annual fluctuations, some quantities were imported in all the years except 1972 when there was a net export of about half a million tons. After three good crop years (1975–76 to 1977–78), there would be no net imports during the current year. The year 1978 opened with a food grain stock of about 17.4 million tons and the production is expected to exceed 125 million tons. The bumper production is also expected to be reflected in record procurement.

The question whether India will continue to be self-sufficient assumes great significance because the entry of India as a large buyer will have a major influence on the international market and will have large implications for the world food situation.

This paper analyzes India's performance in terms of the achievement of self-sufficiency on the basis of past trends in food grains production and consumption, and reviews the proposals for development under the new draft five year plan 1978–83 with a view to evaluate the prospects for achieving continued self-sufficiency.

Trends in Net Availability of Food Grains

The net production and net availability of food grains during the period 1950 to 1977 showed considerable annual fluctuations, the variations in the latter being lower than those in the former (fig. 1B).[2] The imports also varied from year to year, depending upon the shortfalls in production (table 1). No significant long-term trend in per capita availability of food grains is noticed over the period 1950 to 1977 (fig. 1C). Even a three-year average of net availability does not show any consistent upward trend.

On the other hand, the average per capita availability of food grains during 1975–77 at 158.9 kilograms was 5% to 6% lower than that in the triennium 1970–72 and even in 1960–62, when it was 169.4 kilograms and 168.0 kilograms, respectively. The per capita availability of pulses has shown an almost consistent decline. Even after allowing for this, the availability of cereals in 1975–77 shows a decline. Whether this decline is real or apparent needs further investigation. But even if it is to be taken as real, nonavailability of food grains

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[1] In a country where the government undertakes the responsibility for the supply of food grains through a public distribution system at reasonable prices, the goal of self-sufficiency could mean that the requirements for distribution should be met from within the country. Where there are no such arrangements, self-sufficiency could imply that market demand for food grains should equal marketed surpluses of the producers at a reasonable level of prices. For planning production programs, the self-sufficiency objective requires that the production target should equal the gross demand (at constant prices), including the requirements for human consumption as well as those for seed and livestock feed and allowance for wastage.

[2] For definition of net availability, see footnote to table 1.

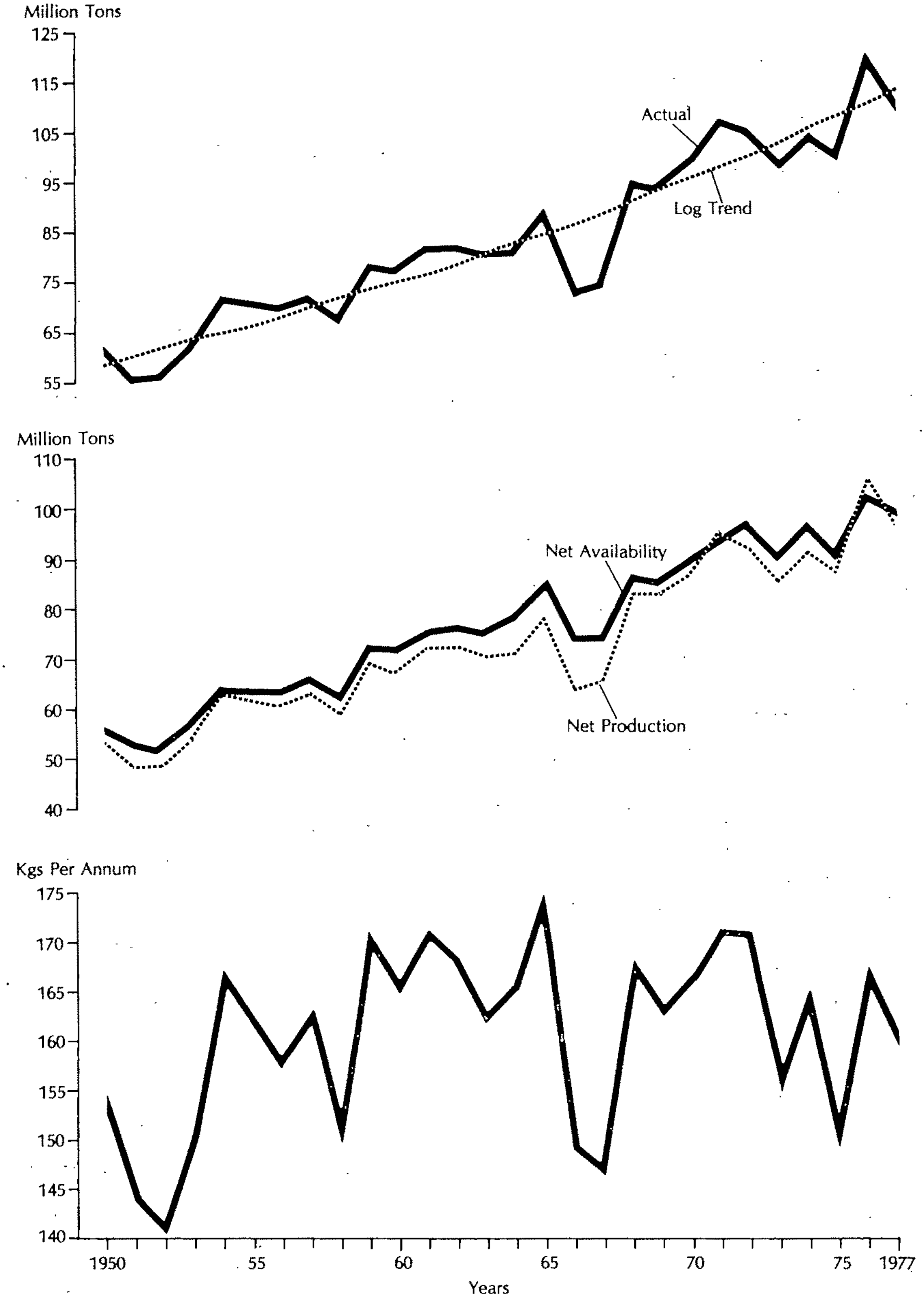

Figure 1A. Food grains production—India 1949–50 to 1976–77

Figure 1B. Net production and net availability of food grains—India 1950 to 1977

Figure 1C. Per capita availability of food grains—India 1950 to 1977

Table 1. Net Availability of Cereals and Pulses, 1950–1977

		Cereals				Pulses	Per Capita Net Availability Per Year		
Year (1)	Population (millions) (2)	Net Production (million tons) (3)	Net Imports (million tons) (4)	Change in Government Stocks (million tons) (5)	Net Availability (million tons) (6)	Net Availability (million tons) (7)	Cereals (8)	Pulses (kg per annum) (9)	Total (10)
1950	357.3	44.41	2.16	n.a.	46.57	8.78	130.3	24.6	154.9
1951	363.2	40.09	4.08	+ 0.59	44.30	8.05	122.0	22.1	144.1
1952	369.3	40.67	3.93	+ 0.62	43.98	7.98	119.1	21.6	140.7
1953	375.6	45.46	2.04	− 0.48	47.97	8.61	127.7	22.9	150.6
1954	382.4	53.55	0.83	+ 0.20	54.19	9.73	141.7	25.4	167.1
1955	389.7	51.70	0.60	− 0.74	53.05	10.11	136.1	25.9	162.0
1956	397.3	50.43	1.39	− 0.60	52.42	10.23	131.9	25.7	157.6
1957	405.5	52.77	3.63	+ 0.86	55.54	10.63	137.0	26.2	163.2
1958	414.0	49.46	3.21	− 0.27	52.94	8.84	127.9	21.3	149.2
1959	423.1	57.39	3.86	+ 0.49	60.75	11.56	143.6	27.3	170.9
1960	432.5	57.10	5.13	+ 1.40	60.82	10.38	140.6	24.0	164.6
1961	442.4	60.89	3.49	− 0.17	64.55	11.14	145.9	25.2	171.1
1962	452.2	61.85	3.64	− 0.36	65.85	10.24	145.6	22.6	168.2
1963	462.0	60.19	4.55	− 0.02	64.76	10.08	140.2	21.8	162.0
1964	472.1	61.79	6.26	− 1.24	69.29	8.81	146.8	18.6	165.4
1965	482.5	67.33	7.45	+ 1.06	73.72	10.85	152.8	22.5	175.3
1966	493.2	54.60	10.34	+ 0.14	64.80	8.68	131.4	17.6	149.0
1967	504.2	57.65	8.66	− 0.26	66.57	7.30	132.0	14.5	146.5
1968	515.4	72.58	5.69	+ 2.04	76.23	10.57	147.9	20.5	168.4
1969	527.0	73.14	3.85	+ 0.46	76.53	9.09	145.2	17.3	162.5
1970	538.9	76.83	3.58	+ 1.12	79.29	10.20	147.2	18.9	166.1
1971	550.8	84.53	2.03	+ 2.57	83.99	10.32	152.5	18.7	171.2
1972	562.5	82.31	(−) .49	− 4.69	86.51	9.70	153.8	17.3	171.2
1973	574.2	76.23	3.59	− 0.31	80.13	8.67	139.5	15.1	154.6
1974	586.1	82.82	4.83	− 0.40	88.05	8.75	150.3	14.9	171.1
1975	597.9	78.59	7.39	+ 5.56	80.42	8.76	134.5	14.6	149.1
1976	609.3	94.50	6.44	+10.27	90.67	11.41	148.8	18.7	167.5
1977	620.1	87.82	0.48	− 1.20	89.50	9.81	144.3	15.8	160.1

Sources: *Bulletin of Food Statistics* published by the Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation; *Economic Survey*, 1977–78, Government of India. N.A. is Not Available; Net Availability is Net Production + net imports ± change in stocks with government; Net Production = 87.5% of gross production. An allowance of 12.5% of gross production is made for seed, livestock feed, and wastage. Because the stocks with producers and traders undergo considerable annual fluctuations, the net availability in a given year does not represent the true consumption in that year, because the data on changes in stocks relate to those with the government only.

within the country cannot be the reason for the decline; for, during this period, the stocks with the government went up from 2.73 million tons at the beginning of 1975 to 17.36 million tons at the end of 1977.

The National Commission on Agriculture compared the estimated increase in the demand for food grains based on changes in population, per capita income, and relative prices during the period 1960–62 to 1970–72 with the actual increase in consumption and found that these two sets of figures were consistent. The effect of increase in income has been very nearly offset by the rise in prices with the result that the per capita consumption in 1970–72 was only marginally higher than that in 1960–62. Extending the method used by the National Commission on Agriculture to the period 1975–77, and comparing it with the relevant data for 1970–72, we find that between these two periods, the average population went up by 10.6% and the per capita income by 2.9%, while the index number of food grain prices relative to all commodity prices declined by 4.6%. The composite effect of these changes should have been to raise the average consumption by 13.8%, whereas it rose by only 3.8%. This difference is too large, and indicates that the estimated demand and actual availability were not in balance.

Taking the two years 1975 and 1976 together, during which accumulation of government stocks took place to the extent of 15.83 million tons, the net imports were 13.83 million tons; thus, the net accumulation of stocks from domestic production was 2 million tons. Even this might represent a part of the transfer of stocks from nongovernment to government hands arising from the comfortable food situation. Taking the provisional figures for 1977 also, the change in stocks over the period 1975–77 was 14.63 million tons and the net imports were 14.31 million tons. Since these two almost tally with each other, the average net domestic production during the three years can be equated with consumption at 96.86 million tons. Since all the available indications such as accumulation of stocks, prices, etc. show that the demand and supply from domestic production were in balance, the discrepancy between the estimated demand and actual availability based on official estimates of production needs to be investigated.

Progress of Food Grains Production

The long-term trend in food grains production shows an annual growth rate of 2.42% during the period 1949–50 to 1976–77. However, various other estimates of the performance of food grains production can be given, depending upon the period over which the growth is assessed and the formula adopted for computation of growth. A detailed analysis of the rates of growth during the period 1949–50 to 1973–74 shows (Mellor, p. 39): (*a*) an annual increase of 2.8% (compound) between 1949–50 and 1960–61; (*b*) a slowing down to 2.1% during the period 1960–61 to 1964–65; (*c*) an accelerated growth of 3.3% per annum during 1965–66 to 1970–71; and (*d*) stagnation in production for several years thereafter. Food grains production picked up again in 1975–76 when it reached the level of 121 million tons. According to unofficial figures, the output in 1977–78 is likely to exceed 125 million tons. If so, the rate of growth between 1960–61 to 1977–78 would work out to 2.5% per annum.

The growth in food grains production also has been analyzed by several research workers by crop and by region, and has been decomposed into its components of area, yield, and cropping patterns. Also, there are some studies that analyze the factors contributing to the growth and the role of price and nonprice factors therein. Some of the significant conclusions are as follows. (*a*) Up to 1960–61, area contributed more to the increase in production than the yield. After 1960–61, nearly four-fifths of the increase in production was due to rising yields. (*b*) Yield increases in the case of wheat were most remarkable, rising at the rate of more than 4% per annum during the latter period. (*c*) Growth rates were uneven in different states, the lowest growth being in the eastern states and the highest in the northwestern states. (*d*) Nonprice factors influenced the relative area shares of food grains crops (Dharm Narain, p. 39).

With regard to performance in terms of program and production targets, while the food production targets in the first two plans were achieved, there had been consistent shortfalls in the achievement of targets of production as well as those of programs, e.g., major irrigation and fertilizer use in the subsequent plans. A detailed analysis of food grains production potential for the period 1950–51 to 1973–74 broken up into two periods, 1950–51 to 1960–61 and 1960–61 to 1973–74, showed that the failure to achieve food grains production-potential targets in the latter period was due to shortfalls in the achievement of physical targets under major and medium irrigation programs and fertilizer consumption (Vaidyanathan, p. 1359).

Recent trends in food grains production do, however, reveal certain important facts: the food grains production graph (fig. 1A) shows that the consecutive peaks and troughs are at successively higher levels, and that the trough points of production in 1976–77 and 1972–73 are higher than the preceding peak points in 1970–71 and 1967–68, respectively. Further, during the last decade, the actual levels of production are higher than the trend values in six out of ten years, and the average of positive deviations from the trend line is higher than that of negative deviations. The proportion of food grains production from irrigated areas is going up. Also the proportion of the production in the Rabi season to total has gone up from 34% in 1966–67 to 40% in 1976–77. These developments have some significance in terms of overall food management in the country.

Demand Estimates 1982–83

The five year plan 1978–83 puts the estimate of India's population in 1983 at 697.2 million, implying a growth rate of 1.92% per annum over the plan period. The per capita private consumption expenditure is assumed to grow at 2.21% per annum consistent with a growth of 4.7% per annum in gross domestic product during the same period.

In estimating the demand for food grains in 1982–83, the effect of redistribution of purchasing power has been taken into account for the first time, and demand estimates have been presented with and without redistribution assumptions at 144 and 140 million tons, respectively. The target of production of food grains for 1982–83 has accordingly been fixed at 140 to 144 million tons, implying a growth rate of

3% to 3.6% per annum over the assumed base level production of 121 million tons in 1977–78.

Programs under the 1978–83 Plan

The realization of the target of food grains production is based on the following major programs which have been provided for in the plan in terms of financial, organizational, and policy measures and instruments.

Irrigation. The area benefited by irrigation schemes is proposed to be stepped up by 17 mha potential, comprising 8 mha from major and medium schemes and 9 mha from minor schemes for which a total allocation of 89,750 million rupees (Rs) has been made for the years 1978–83 as compared to Rs 38,810 million in the fifth plan. The actual utilization is expected to be 15 mha, raising the area under irrigation from 48 mha in 1977–78 to 63 mha in 1982–83.

Gross cropped area. The gross cropped area is expected to go up by 6 mha (i.e., from 174 mha to 180 mha) largely as a result of bringing new irrigation benefits and improvement of irrigation on areas already irrigated.

Fertilizers. The consumption of chemical fertilizers is proposed to be raised from 4.2 million tons of NPK in 1977–78 to 7.85 million tons in 1982–83, comprising 5.25 million tons of nitrogen, 1.6 million tons of phosphatic, and 1.0 million tons of potassic fertilizers. Eighty percent of the requirement of nitrogenous fertilizers and 70% of phosphatic fertilizers will be met from indigenous production, while provision has been made for import of the balance of requirements including the whole of potassic fertilizers.

Agricultural credit. The total credit available to farmers is proposed to be doubled during the next three years, from the current level of Rs 22,950 million comprising Rs 16,500 million short-term, Rs 2,350 million medium-term and Rs 4,100 million long-term credit. This is hoped to be achieved through progressive institutionalization with a multiagency approach and the earmarking of an increasingly larger share for the weaker sections.

Agricultural research. The agricultural research system is being reorganized and strengthened with emphasis on operational research programs. The thirty Central Research Institutes under the Indian Council of Agricultural Research, the twenty-one agricultural universities and fifty-two All-India Coordinated Research Projects are the principal agencies through which research is being organized. The allocation for agricultural research and education has been doubled from Rs 2,100 million in the fifth plan to Rs 4,250 million in the next plan.

Extension. The Training and Visits system of extension, already found to be effective; is proposed to be expanded to cover larger areas.

Land use planning and planning from below. While reliance for the achievement of the faster rate of growth is being placed on the programs and policies briefly mentioned above, there are two other elements referred to in the plan, but on which adequate emphasis has not been placed so far in the implementation stage. These are land-use planning and planning from below in the agricultural sector. These are crucial to the realization of the targets.

Prospects for Self-Sufficiency

That there is potential in the country for an accelerated development of food and agricultural production is recognized. This question also has been studied recently by the National Commission on Agriculture which made detailed recommendations, the implementation of which will help in realizing the potential. The policies at the macro level already have evolved over time, and the deficiencies in the use of irrigation water, the arrangements for the multiplication and distribution of improved seeds, supply of fertilizers, availability of credit, and the research and extension systems have been reviewed continuously. These programs have been modified in the light of experience wherever necessary. The government has given high priority for agricultural development, and this is reflected in increased allocations made for irrigation and other agricultural production programs. The accelerated targets for irrigation and fertilizer use are capable of achievement from the technical, financial, and institutional angles and when achieved will be reflected in the production levels.

Even in the past, several programs have succeeded in some areas, while they have not done so in others because of widely varying levels of agroclimatic endowments or due to the prevalence of several constraints or barriers to the adoption of new technology, by way of technological, organizational, institutional, and economic and social factors, inhibiting their adoption in the local area or situation. The high-yielding crop variety technology is neutral to scale, but for its adoption, the small farmer needs resources. The small farmer may have access to credit, but before the lending institution makes it available to him he should have a clear title to the land he cultivates. This requires the existence of a good land records system. Groundwater may be available, but its use by a small farmer depends upon small farmers coming together as a group so that they can go in for a tubewell or masonry well jointly. Optimum results can be obtained if the fertilizer recommendations are based on soil tests in each farmer's field, but the existing facilities for soil testing may not be extensive. These are some of the constraints and barriers to the adoption of new technology. Solutions to these problems may have been arrived at in the shape of macrolevel policies and institutions; but for removing the constraints and barriers, these problems need to be identified at the local level, and solutions applicable at the local level need to be adopted. This calls for a development organization which is specifically entrusted with this task.

The main conclusions that emerge from the analysis presented in the paper may be briefly recapitulated here:

(*a*) The per capita availability of food grains over the period 1950 to 1977 does not show any definite long-term trend. However, on the basis of available estimates of domestic production, the average per capita availability in the triennium 1975–77 turns out to be lower than that during 1970–72 and even 1960–62. At the same time, during the period 1975–77, the demand for food grains has been met entirely from domestic production, as is evident from the accumulation of stocks and easy price situation; this being so, the causes for the apparent decline in per capita consumption need further investigation.

(*b*) The estimates of demand for food grains in 1982–83 envisaged by the Planning Commission indicate a level of 140–144 million tons with alternative assumptions regarding redistribution of purchasing power. This is also the production target proposed for the last year of the new five-year plan 1978–83. The achievement of this target implies a growth rate of 3% to 3.6% per annum over the base level production of 121 million tons in 1977–78. This rate of growth is more modest compared to the rates aimed at in the previous plans, though higher than the long-term growth achieved during 1949–50 to 1976–77 or even 1960–61 to 1976–77.

(*c*) The physical targets in respect of irrigation, fertilizer use, and credit supply represent a considerable step-up over those in the previous plans, are supported by financial provisions and policies, and seem to be capable of achievement, particularly in view of infrastructure that has been built up over the years.

(*d*) To ensure that the potential which is created is actually utilized by the farmers at the local level, what is required more importantly is an appropriate development organization which will look into the bottle necks and barriers standing in the way of adoption of new technology at that level and take remedial action.

Unless, therefore, the growth in demand for food grains turns out to be substantially larger than expected, there is a high probability that India will be able to meet her food grain requirements from domestic production and will not have to go in for large-scale imports except in years of severe drought. The existence of large buffer stocks will enable the country to tide over temporary shortages arising from adverse weather.

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Import Substitution and Implicit Taxation of Agriculture in Brazil

Eliseu Roberto de Andrade Alves and Affonso Celso Pastore

The industrialization that Brazil experienced prior to World War II was not induced by the government. It had its origin in the relative profitability of the agricultural and industrial sectors, which favored a shift in resources to the industrial sector. During the period from the end of World War II until the early sixties, a deliberate import-substitution policy was pursued. The factors that gave rise to that policy were the difficulty that the country encountered in foreign trade during the Depression and the two world wars, the influence of the Prebish thesis, and the dominance of two-sector models (Rannis and Fei, and Jorgenson) as the basis for development policies.

Brazilian industrialization policy was based upon three principles: protection against international competition, easy access to capital, and stable wages. This constituted a policy to transfer resources generated in agriculture to industry, thus penalizing the primary sector.

The period after World War II witnessed an industrial growth never before seen in Brazilian history. Industrialization generated strong pressures for urbanization, with the result that, by 1970, 56% of the population was urban. This created pressures on the supply of food and fibers.

This paper attempts to review some effects of industrialization on agriculture. It concentrates on economic and trade policies that resulted in the implicit or explicit taxation of agriculture.

Brazilian Trade Policies, 1946–77

This section draws heavily upon studies by Martin, Melo, and Veiga, where a detailed description of the various trade policies may be found. The import policies were designed to stimulate industrialization by protecting the industrial sector against foreign competition and by reducing the cost of capital. These policies also aimed at controlling imports to solve the problem of recurrent trade deficits.

Export policy was based on an "exportable surplus" model (Leff). Trade policy in the period that extended from the end of World War II to 1964 was characterized by a strong bias against exports, thereby discriminating heavily against agriculture. After 1964 most export controls were eliminated and discrimination against exports was reduced substantially in respect to industrial products. In 1968 export promotion policies were established to stimulate the exports of industrial products. The benefits of such policies for agricultural products were small. Moreover, in the case of some agricultural products, outright export prohibition continued when government authorities believed agricultural prices were rising "too rapidly" and/or that "scarcity" could occur in the domestic market.

Trade policies during this period provided strong protection to industry. Bergsman and Candal indicate that effective protection was 190% for consumption goods, 50% for intermediate goods, and 15% for capital goods. The effective protection for agriculture, on the other hand, was negative. Moreover, in the period 1954–59 the effective exchange rate for imports varied from 2.4 to 4.0 times the effective exchange rate for exports.

The result of these policies was the transferance of a substantial amount of resources from agriculture to industry. Fishlow estimates the amount transferred from agriculture to vary from 2.1% to 7.3% of industrial gross national product (GNP) in the period 1955–57, and to range from 11.6% to 19.1% in the period 1958–60.

Trade policy was modified several times in the period 1946–64. Quantitative controls to restrict imports prevailed from 1947 to 1954. Multiple exchange rates for exports were established in the period 1953–57. Ad valorem

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tariffs were introduced in 1957, and substantially increased the protection provided industry. For the general category of imports these tariffs could reach 80% of the value of the good. For the specific category they could be as high as 150%, with further increases permitted by an exchange rate charge that varied from 100% to 200%.

In the period 1964–67, an effort was made to simplify the trade regulations and to open the economy to international markets. The external debt was refinanced, the government tried to keep imports to a minimum, it started to encourage exports, and it began efforts to fight the serious domestic inflation. Means of encouraging exports consisted of not only more frequent devaluation of the cruzeiro but also some reductions in the "contribution quotas" made by coffee and cocoa exporters. However, in January 1965, a 30% "contribution quota" was placed on beef exports. Ad valorem tariffs on some export commodities were reduced however.

Policies initiated in the previous period were carried over into the 1967–73 period. Continued efforts were made to reduce trade distortions. Tariffs were reduced, exchange rates were further unified, and the multiple exchange rates were eliminated.

The major new policy innovation was the introduction of the floating peg exchange rate system. This consisted of frequent "mini-devaluations" that occurred seven to eight times per year. These were at first made at regular intervals, but later they were randomized to discourage exchange market speculation. The basic rule followed was to devalue the cruzeiro at a rate approximately equal to the difference between Brazil's internal inflation and the average inflation of Brazil's major trading partners, predominantly the United States, Western Europe, and Japan.

Most export controls were eliminated, although some controls were maintained on coffee and cocoa. Various fiscal, credit, and exchange rate policies were used to provide incentives to export, although these were directed more to the industrial sector than to the agricultural sector. The government provided special incentives to stimulate exports by private firms, such as exemption from excise taxes on all exports, exemption from sales taxes on certain products used in production for export, exemption of export earnings from income tax or reduction of such tax, credit to finance export sales and export promotion at overseas trade exhibitions.

Bacha and colleagues estimate that the cruzeiro was overvalued from 20% to 25% in the early to mid-1960s. Pastore and colleagues (1976b) estimated that the exchange rate that would bring equilibrium to the balance of commerce was close to the observed rate for the period 1970–73. This suggests the elimination of part of the trade distortions brought about by changes in trade policies in the period 1964–73.

Oil prices increased fourfold in October 1973. After six years of positive results for the balance of payment, with a surplus of US$1.6 billion in 1973, a substantial deficit of US$938 million occurred in 1974. The choice made by the government to curb the crisis in the balance of commerce was to reintroduce import controls. The ad valorem tariffs were raised, and outright prohibition to import and other measures to reduce imports were imposed. The cruzeiro became overvalued again and preliminary estimates reported by Rosa place the rate of overvaluation between 25% and 35%. The rate of inflation rose to 40%, and price controls on agricultural products became frequent again. The export policy for industrial products was carried over, with minor modifications, into the period 1973–77.

Trade Policies and the Distribution of Income

One consequence of the trade policies was to reduce the cost of capital to industry. At the same time, wage policy raised the private cost of labor well above its social cost (Bacha et al.). The combination of cheap capital and high-cost labor caused the industrial sector to have a low absorptive capacity for labor. In 1964, the industrial sector accounted for 35% of GNP while the share in employment was only about 8%. This was far below the comparative share in other countries with a similar degree of industrialization (Bergsman and Candal).

The low capacity of the industrial sector to absorb labor caused labor to be dammed up in agriculture, with the result that a large flow of rural–urban migrants was channeled into the low productivity service sector or accumulated as urban unemployed. The average productivity of labor in industry, which in 1950 was 6.4 times greater than the average productivity of labor in agriculture, increased to 11.6 times in 1970. In a sense this indicates a worsening in the distribution of income between the two sectors.

The link between trade strategies and employment is complex. According to Krueger, "it involves not only trade strategies themselves and the structure of the labor market but also entails examination of various factors which contribute to distorting goods and factor markets" (p. 270). Three linkages which hold simultaneously can be identified. First, there is the effect of the trade strategy on the overall rate of growth and in turn on the rate of growth of employment opportunities. In the case of Brazil, Valderrama has studied the impact of the export subsidies for industrial products on the growth of the economy and the growth of exports. His results do not support the idea that the subsidies for industrial products fostered either the growth of the economy or the growth of exports.

A second linkage is the effect on the demand for labor via the influence of the trade strategy on the composition of output. If a trade strategy results in a higher proportion of GNP originating in labor-intensive industries, the selection of the strategy will result unequivocally in a higher demand for labor (at a given real wage) than will the selection of the alternative. The third linkage is the effect that the trade regime has on factor prices. To the extent that trade policy results in incentives for the use of capital-intensive techniques, it affects the demand for labor.

The trade strategies of 1946–73 discriminated severely against agriculture. To the extent that agriculture is more labor-intensive than industry, trade policy reduced the overall demand for labor, other things being equal. Data provided by Mendonca de Barros (1973) suggest that the export promotion strategies benefited relatively more those industries with a high capital-output ratio and which also require labor with a high level of training and specialization. This led to an increase in the demand for a type of labor that was in short supply, and hence contributed to a worsening in the distribution of income (Langoni).

The overvalued exchange rate and selected export subsidies also distorted internal prices. Pastore and colleagues (1967) conclude that elimination of these distortions would raise the relative price of products consumed by the poor. At the same time, the price of products consumed by the rich would decline. Hence, correction of the distortions would aggravate the distribution of income problem, at least in the short run.

A similar point has been made by Schuh (1977) in respect to agricultural products. If export restrictions were eliminated the short-run effect would be an increase in agricultural prices, to the detriment of low income groups. The effect on the rich would be weaker since the consumption of food is a small share of their total consumption.

Trade policy also had a number of effects that were detrimental to regions outside of the industrial Southeast. First, these regions were forced to pay higher prices for those consumption and capital goods produced behind the protective tariff wall than they would have paid if they had been able to import them at nondistorted prices. Second, capital which could have been invested in their own development was transferred out of these regions by means of trade policy. The loss of capital meant that the capital-supplying regions could not provide additional employment for their population, nor finance needed improvements in their basic infrastructure such as education, roads, or agricultural research and extension activities. From about 1950 until 1961 the Northeast experienced an average annual transfer of capital to São Paulo of about US$25 million. For the entire country outside of the State of São Paulo the transfer to this state was about US$31 million (Martin, p. 304).

Starting in 1962, the resource flow among regions through the terms of trade reversed. The factors affecting this reverse flow included the trade reforms starting in 1964, the rise in international commodity prices (in 1969), and government programs designed to help the Northeast.

Trade Policies and Productivity Growth in Agriculture

Trade policy had a positive effect on agriculture by means of the large urban-industrial complexes that arose as a consequence of import-substituting industrialization. Agriculture benefited from the expansion of the nonfarm labor market which increased the number and kinds of jobs available to prospective migrants. This speeded up the migration process, and as the opportunity cost of labor increased, a reorganization of agriculture was induced. The market for agricultural commodities became large and predominantly located at a few growth poles. Agriculture located close to these poles could operate at lower average cost—either because of increased specialization or because of the realization of economies of scale. With the concentration of production, more social-overhead capital was provided. This included roads, which lowered transportation costs, and improved educational facilities, which increased labor mobility and raised labor productivity (Schuh, 1969).

Recent literature stresses the role of periodic food supply crises on policy making (Smith). The urban-industrial complexes were very sensitive to food shortages and hence were an instrument of pressure on the government to shape an agriculture policy that would increase the production of agricultural commodities at a lower cost. In the short run, the signs of crisis were frequently misinterpreted. Price and export controls were established for agricultural products to lower or to restrain the increase of the prices. But the crises eventually brought about a change in policy, with greater emphasis on increasing agricultural productivity.

The negative effects of trade policies are related to the participation of agriculture in international trade. This participation could have been larger if it were not for the restrictions that stemmed from an overvalued currency and in certain cases from outright prohibitions against the exports of agricultural products. The negative effects also are related to the fact that agriculture could have had access to lower-priced inputs if it were not for the protection given to the industrial sector. The increase in price for modern inputs was a severe restriction to the modernization of agriculture.

Mendonca de Barros and Graham recently constructed aggregate indices for production and productivity of Brazilian agriculture. They considered two regions and compared them with the State of São Paulo. The results were also aggregated for all of Brazil. One region was the poverty-stricken and densely populated Northeast, while the second region included all other states except São Paulo, the Northeast, and the North region (the Center-South). The two regions and the State of São Paulo combined account for about 90% of the agricultural output of the country.

Two classes of products were considered: one included products for the domestic market and the other products for foreign markets. At the aggregate level the annual rate of increase of production for domestic products was 4.4% for the period 1932–76, 4.0% for the period 1962–76, and 3.3% for the period 1968–76. On the other hand, if one excludes coffee from the export products, the annual rates of increase of production for this class of products were 5.3% for the period 1932–76, 7.2% for the period 1962–76, and 9.8% for the period 1968–76. When coffee was included among the export products, the annual rates of growth for this class of products declined to 4.4% for the period 1932–76, 4.0% for the period 1962–76, and, finally, to 3.3% for the period 1968–76.

Given that population was growing at a rate of 2.7% per year, per capita income was increasing at a rate of 6.0% per year, and assuming an income elasticity of demand of 0.5, it appears that domestic demand was increasing at a rate of 6.0% per year. Hence, although the aggregate rates of growth of production were greater than the rate of increase of population, they were not keeping pace with the increase in demand. This was reflected in an upward trend in agricultural prices in recent times. Moreover, products for the domestic markets were being replaced at the production level by export products. This probably aggravated the nutritional problems of the low income classes. Turning to the productivity of land, in São Paulo the productivity for export products (with coffee) increased at a rate of 8.1% per year for the period 1962–76 and 12.6% for the period 1968–76. If coffee is excluded from the export products, there was no increase in land productivity in the period 1968–76, but the increase was at an annual rate of 5.0% in the period 1962–76. Productivity of land for domestic products increased at a rate of 5.3% and 8.0%, respectively, for the periods 1962–76 and 1968–76.

Coffee is not an important product in the Northeast region. The rates of growth of productivity for the export products were 2.5% in the period 1962–76 and 4.0% in the period 1968–76. There was no increase in the productivity of land for domestic products in the period 1962–76, while for the 1968–76 period there was actually a decline in productivity (at a rate of 4.5% per year).

In the Center-South region there was no change in the productivity of land dedicated to export products for either period. If coffee is excluded from the index, the productivity of land for export products increased at an annual rate of 3.4% for the period 1962–76, but there was no increase for the 1968–76 period. The rate of increase of productivity for domestic products for the period 1962–76 was 1.6%. Again, no increase was observed for the 1968–76 period.

For purposes of analysis two questions can be posed: Why were the observed rates of increase of productivity higher in São Paulo than in other regions, and why was the performance of agriculture in general relatively modest? The answers can be found in de Janvry's socioeconomic model of induced innovation, which puts the emphasis on stress, synonymous with falling profits. This idea can be used to further clarify the role of the urban industrial complexes in the modernization of agriculture. But in the case of Brazil, stress is a consequence of increases in the price of food for the urban sector and of the need to expand exports so as to pay for a growing demand for imports brought about by industrialization. The urban population is very sensitive to food shortages and has considerable capacity to influence government to modify agricultural policy so as to increase the supply of food.

To respond to the first question, it is clear that the agriculture located closer to urban industrial complexes can obtain more benefits from them than the agriculture which is farther away. The benefits would come as a consequence of agglomeration, and of agricultural policy on the part of both the federal and state governments that is better designed to avoid a shortage of food and to foster the production of export products. To exemplify, it is well known that São Paulo has invested much more in research and extension than the other states (Smith).

The distortions created by the trade policies also helped São Paulo to develop its extension and research institutions because the state benefited from a substantial resource flow from the rest of the country. The agriculture of the State of São Paulo also benefited from the fact that its urban industrial complexes were developed earlier than in the other states. Martin has shown that the level of urban industrial development plays an important role in explaining why some states invested more than others in these activities.

Martin drew on previous works by Thompson to calculate the internal rate of return that would be realized if the states taken together were to invest in research and extension in the same proportion as São Paulo. Two experiments were performed. The first one maintained for the rest of Brazil (the aggregate of the other states) the same ratio of technicians per 10,000 rural workers as for São Paulo. This would have required that the other states taken together would have had to employ 31,675 technicians. They were in fact employing only 8,189 technicians in 1970, as compared to São Paulo's 2,978 technicians. The other experiment maintained for the rest of the country the same ratio of technicians per Cr$10,000 of value of agricultural production. In this case the other states taken together would have employed 11,133 technicians. The internal rate of return was 18% for the first experiment and 28% for the second, both of which compare well with the 20% rate of return found for the State of São Paulo.

The second question is addressed to the rather modest performance of the agricultural sector. The literature on this subject is extensive. But it can be reduced to three lines of thought. The first was popular in the early 1960s and gave a great deal of emphasis to the size distribution of land. The basic proposition that stems from it is agrarian reform (Cline). The second line of thought is in the neoclassical tradition and considers the industrialization policies—trade distortions, price and export controls, etc. as negatively affecting the modernization of agriculture (Schuh 1974). The Hayami and Ruttan book inspired the third line of thought. The abundance of land and labor that prevailed in a long period of Brazilian history acted as a brake for the modernization of agriculture, leading to agricultural policies strongly biased toward an increase of cultivated area as opposed to an increase of productivity (Pastore, Alves, Rizzieri; Schuh 1974).

The overvaluation of the currency is an implicit tax on the agricultural sector. The predicted effects of this tax indicate a reduction in the use of land, labor, and capital, and a transfer of resources to the urban sectors. These negative effects were aggravated by the fact the industrialization policies increased the prices of modern inputs. Hence the trade policies subjected agriculture to a double squeeze, decreasing the price of agricultural products and increasing the costs of production. There were some compensating measures through subsidies in the form of cheap credit, but these measures led to still further distortions.

Lopes has evaluated the consequences of an overvalued currency on the agricultural sector. He examined the effects of a decrease of 10% in the price of agricultural products. This shift in the internal terms of trade would reduce the use of labor in agriculture by approximately 18%, release about 27% of the mobile capital in agriculture for investment in the nonfarm sector, and reduce land use by about 10%.

He also found that the value marginal product of labor in agriculture would decline by approximately 15%. When this is combined with the overvaluation of labor in the industrial sector due to the protection of that sector, one begins to understand the large income differential that has emerged between the industrial and agricultural sector in Brazil. The reduction in land also explains the underutilization of land that is common in Brazil. This finding also helps to explain why there were no strong incentives for farmers to use land-saving technology. Hence, in a real sense, trade policies were detrimental to the modernization of agriculture.

Conclusion

The rapid industrialization of Brazil succeeded in changing its product mix in a short period of time. An urban-industrial complex was created, which in 1975 already accounted for 89.5% of national income. Moreover, 62% of the population was living in the cities (IBGE). Growth rates were very high in the 1965–76 period, with GNP per capita growing 6.2% per year and total GNP increasing at a rate of 9.2% per year (*Conjuntura Economica*).

There is growing concern on the part of commercial partners of Brazil in relation to her present trade policies. This concern will probably induce changes that will benefit the exports of products originating in agriculture and those that have high labor content. However, increased per capita income, a high rate of population growth and urbanization, and the need to export more every year will result in accelerating demand for food and fiber from Brazil's agricultural sector. A food crisis will emerge unless production shows a major increase, and the results reported herein suggest that the supply of food and fibers is probably lagging behind the growth of demand.

Brazil in the past could count on an agricultural frontier with favorable ecological conditions. The remaining frontier has continental size, but is far removed from population centers and requires huge capital investments in infrastructure. It also needs large investments in research and development of new agricultural technology which up to now were not produced in other countries or other areas of Brazil.

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Chinese Agriculture: Continued Self-Reliance

Thomas B. Wiens

The relationship between the economic situation of the Peoples' Republic of China (PRC) and the international grain market can be summarized succinctly. Over the past two decades, the average annual growth rates of food grains production and population in China have not differed greatly, and the per capita food grains supply in 1977 cannot have been much greater than it was in 1957. At current population growth rates, which perhaps have fallen as low as 1.7% per year (Aird), failure to sustain a positive food-grains growth rate would result in either declining per capita consumption or an average annual increase in food grains imports of 4–5 million tons. The former would be politically unacceptable and the latter eventually would be economically crippling, because there is no indication that China can generate enough foreign exchange to pay for both substantially increasing grain imports and the modern technology which it currently demands. It is therefore imperative for PRC to continue to pursue policies intended to maintain at least approximate self-sufficiency.[1]

This considerably understates Chinese intentions, however. In recent months, the Chinese government has enunciated unusually high targets for agricultural growth and defined the policies and technological improvements required to attain them. Food grains (including soybeans) output, currently at a level of more than 280 million tons per year, is supposed to reach 400 million tons by 1985, requiring average annual growth of 4.5%. Other components of agricultural production are expected to grow at similar rates. China's population control program has been given further priority, and a concrete target set for 1980 of reduction to a 1% annual growth rate (*Foreign Broadcast Information Service: PRC,* hereafter cited as FBIS, 11 July 1978: E20). If China's achievements fell well short of these goals the PRC could be expected to play a moderately significant role in world grain trade only sporadically, in years when poor harvests forced a drawdown of stocks. However, should China even approach its plan targets, it conceivably could become an exporter of wheat and corn as well as rice, and/or of meat and other subsidiary food products in greater quantity. Consequently, I will examine both the past performance and the new program which will determine the prospects for higher future growth.

Past Performance

China's past performance as a food grains producer is difficult to evaluate because of uncertainties attached to Western reconstructions of Chinese production statistics and the problem of choosing representative time periods. The U.S. Department of Agriculture estimates, shown in table 1 for several benchmark years, will here be accepted (but compare Field). If one chooses as a base 1957, the last year of the First Five-Year Plan, then the long-run average annual growth rate of food grains (including or excluding soybeans) has been 2.0%. Measured from 1964, when agriculture had recovered from the declines of the Great Leap Forward, the rate rises to over 2.6%; since 1970, the rate has averaged 2.1% (or higher on some interpretations of Chinese official claims). The statistics do not give the impression of a recent acceleration in growth, but the negative impact of poor weather in the last three years may distort the picture.

Although it is difficult to assign relative importance to the various factors, long-run growth in food production can be attributed to corresponding improvements in technology, management, and the supply of modern and traditional inputs.

Substantial credit must be given to a suc-

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[1] To keep citations and tables to a minimum, readers are referred to Wiens 1978a, 1978b, and 1979 for full documentation of generalizations for which no source is given.

Table 1. Area, Yield, and Production of Grains, People's Republic of China, Selected Years (Area in Million Hectares, Yields in Tons/ha., and Production in Million Tons)

	Total Grain[a]			Rice			Wheat		
Year	Area	Yield	Production	Area	Yield	Production	Area	Yield	Production
1949	101.6	1.06	108.1	25.7	1.89	48.6	21.5	0.64	13.8
1952	112.3	1.38	154.4	28.4	2.41	68.4	24.8	0.73	18.1
1957	120.9	1.53	185.0	32.2	2.70	86.8	27.5	0.86	23.6
1964	121.8	1.64	200.0	29.5	3.05	90.0	25.5	0.98	25.0
1967	127.1	1.81	230.0	30.3	3.30	100.0	25.5	1.10	28.0
1970	129.8	1.85	240.0	31.5	3.49	110.0	25.6	1.21	31.0
1974	134.7	1.97	265.0	35.1	3.63	127.5	27.2	1.40	38.0
1975	136.5	1.98	270.0	35.5	3.56	126.5	27.7	1.48	41.0
1976	137.5	1.98	272.0	35.9	3.50	125.5	28.5	1.58	45.0
1977	139.1	1.94	270.0	36.2	3.49	126.5	27.5	1.47	40.5

Source: USDA, appendix table 2, p. 29.

[a] excluding soybeans, but including tubers on a grain-equivalent basis of 4:1 in 1949–1957 and 5:1 thereafter.

cessful seed breeding and extension program, which has created dwarf rice varieties of high yield and early maturity, now grown on 80% of China's rice acreage; F1 hybrid maize, extended to 40% of maize acreage by 1973; and rust-resistant and semi-dwarf winter wheat varieties with high yield potential under intensive cultivation conditions.

Improvements in irrigation and drainage played a major role. There has been a more-than-30% increase in irrigated acreage since 1957, and a great improvement in the quality of irrigation, including a general replacement of human and animal-powered equipment with electric or diesel-powered pumps. The major extension in area irrigated is attributable to over a million mechanically-powered tubewells installed in the north China plain over the last decade, which, in turn, must take credit for the rapid growth of wheat yields.

The growth of total nutrient availability has been rapid, at perhaps 6% per year between 1962 and 1971. Use of organic fertilizers has traditionally been high in China, but has continued to grow, due both to the increased pig stock and improved utilization. The supply of chemical fertilizers has grown at an accelerating rate, with nutrient application levels from chemical sources approaching or exceeding 100 kilograms per hectare in some regions. Nutrient of all kinds, from all sources, now must average over 200 kilograms per hectare nationally.

Chinese agriculture has become mechanized gradually, although not to the extent of net replacement of labor. The emphases have been on irrigation machinery, medium-sized or garden tractors, and simple processing machinery (Erisman).

It is believed generally that there has been no net expansion of cultivated acreage over the last two decades, with land reclamation outweighed by the encroachment of irrigation systems and other forms of construction (Perkins). Sown acreage has increased, however, through growth of multiple cropping, although the rate of increase is not high. Over the same period, there has been a steady growth of the agricultural labor force, and a tendency to more fully utilize it, albeit generally at land improvement tasks with long gestation periods or low payout ratios.

Finally, organization and management have been stabilized, at least relative to the counterproductive experiments of the Great Leap Forward period. Subject to some ideological constraints and the peccadilloes of local leadership, agricultural planning has been reasonably decentralized, a more cautious attitude taken toward the promotion of technical innovations, and actual field management has been lodged at the level of the production team, a unit of only a score or so families. Private plots and rural free markets have been maintained generally, although limited in size and scope of activity.

Future Agricultural Growth Plans

In briefly summarizing the positive factors which collectively account for two decades of growth, I have ignored the qualifications or caveats which explain why growth rates were less than spectacular. However, these will become apparent as we now consider how the current leadership expects to double the growth rate over the next eight years.

The overall program for agriculture in China through 1985, which was outlined by Chairman Hua Kuo-feng in March, encompasses a partial modernization and mechanization of production processes and certain policy changes aimed at increasing efficiency and incentives. Although the details are still emerging, and will continue to change in response to practical experience and the results of revived research programs in agricultural science and economics, I will outline below what the major influences contributing to increased growth rates will be.

Seed Breeding

The effects of the replacement of conventional varieties of rice by high-yielding dwarfs were largely exhausted by the early 1970s, and the low yields of second or third crops of rice in China's multiple-cropping sequence have since held back growth in the south. However, the Chinese now appear to have made a significant production breakthrough via the introduction of male-sterile, F1 hybrid paddy rice, which was planted on 5% of total rice acreage in 1977 and will be planted on 15% this year. Last year, as a middle or late rice, it added around one ton per hectare (a 20%–30% increase) over conventional dwarf hybrids. Interestingly, its parentage includes an advanced International Rice Research Institute (IRRI) line, and this, rather than "hybrid vigor," may explain its yield superiority. Its maturation period is about ten days longer than current late varieties, reducing the advantage of multiple cropping, and its optimal planting density lower by a factor of ten than normal Chinese practice, all suggesting a new Chinese willingness to throw out longstanding technological prejudices when superior technologies can be found.

Growth in the wheat region due in part to improved seeds does not seem to have played out, despite temporary setbacks attributable to drought. Centro Internacional de Mejoramiento de Maiz y Trigo (CYMMIT), the Mexico-based international maize and wheat breeding institute, has reported that their genetic stock found its way into new Chinese semidwarf wheat hybrids beginning a few years ago, and that the new hybrids have spread rapidly in both north and south China. F1 corn hybrids, a second generation developed in the late 1960s, also continue to displace lower-yielding coarse grains.

The major remaining weaknesses of China's reservoir of food grains germ plasm now seem limited to some coarse grains, soybeans, and tubers. However, China claims success in the breeding of so-called "distant hybrids," including maize-rice, sorghum-rice, reed-rice, sorghum-sugar cane, maize-millet, wheat-rye (triticale), and wheat-elytigia. Of these, the last two at least have been successful enough to reach the popularization stage. These crops combine favorable characteristics of both parents, e.g., the high yields and good quality of wheat with the drought and pest-resistance of rye, or the grain-plus-sugar yield of sorghum-sugar cane.

No major breakthroughs have yet been reported for soybeans or other oilseeds, but current policy calls for rapid restoration of acreage in these crops to meet the shortage of edible oils. Since record rapeseed production has already been claimed for 1978, and soybean acreage is up sharply, I would predict no further imports of soybeans in the near future.

Several other developments have bearing on long-run breeding prospects: China has now entered into active, if informal, exchanges of personnel and breeding materials with institutions such as IRRI and CIMMYT, and thereby will gain access to wider sources of genetic variation, including especially pest and disease resistance. Formal seed banks are now being set up to collect and multiply domestic and foreign germ plasm. Finally, Chinese research activity in monoploid breeding techniques (pollen culture) is well advanced, and has been applied successfully in breeding several types of food grains. When a breeding effort is assigned high priority, the lag time between initial cross and production planting in China is shorter than in any other country. Because the last remaining obstacle in this area, the suppression of pure research and the emasculation of universities and research institutes since the Cultural Revolution, has now been swept aside, the prospects are favorable for a much more rapid advance.

Irrigation Development

With nearly half of China's cultivated area now under some form of irrigation, it is frequently argued in the West that gains due to extension or improvement of irrigation in the future will be either small or extremely costly (Perkins). This view is not shared by Chinese planners.

Many of China's surface irrigation projects have not reached designed capacity, due to such factors as mismanagement, water losses in conveyance, and failure to complete ditch-digging and land-leveling work. For example, Kirin province notes that existing irrigation projects are utilized to only 50% of designed capacity; Shensi sees achievement of full utilization as its main immediate target for farmland capital construction. Hopei has discovered that 40% of its installed tubewell pumps were inoperative, either because of maintenance problems or shortages of fuel and electricity. Closing the substantial gap between potential and actual irrigation capabilities is the main thrust of short-run plans for China as a whole.

Current surface-flow and well irrigation is of little value in hilly or mountainous areas, where the cost of pumping water through channels to small, terraced fields is often prohibitive. This situation characterizes many interior provinces in north and south China, including several, such as Szechuan, where growth in the past has been slow. Now Szechuan and several neighboring provinces have become large-scale testing grounds for a potential remedy, sprinkler irrigation, which saves water, labor, and the land absorbed by canals, ditches, and furrows in surface-flow systems. Sprinkler irrigation also is being developed in the frontier areas and grasslands, where water supplies must be stretched thin over wide areas without the heavy labor investment demanded by surface-flow systems. As another reflection of changing attitudes, it is noteworthy that American firms have begun setting up a 50,000 hectare demonstration farm on China's northeastern frontier, combining a completely mechanized operation with the rotating, sprinkler irrigation systems now popular in parts of the American west.

As for large-scale surface irrigation schemes, the current ten-year plan includes a project for diverting water from the Yangtse River over 500 kilometers to the north to irrigate the north China plains. The investment cost will not be exhorbitant, because the project basically links several existing water courses, including the Grand Canal and adds to mammoth pumping facilities which are already operational. The project eventually should have a significant impact on winter wheat and summer corn production in eastern Hopei and western Shantung.

Fertilizer

Production of chemical fertilizers is currently in the midst of a quantum jump, as thirteen major urea-ammonia complexes constructed with foreign assistance come on stream, potentially adding 3.5 million tons of nitrogen to current production levels of over 7 million tons. The numbers and production levels of smaller-scale domestic plants continue to expand, and an increase of 58% in total product is targeted for 1980 (USDA). Imports of over one million tons (nutrient weight) per year nevertheless continue, and the planned rapid expansion of pig raising may contribute more nutrient from organic sources.

It is more difficult to assess the effects of greater nutrient availability: if nutrient supplied from organic sources is ignored, marginal response rates would be expected to be high, but this is not confirmed by such correlations as can be derived from aggregated data. If both the high levels of organic fertilizer use and other constraints limiting productivity increases are considered, fairly low response rates are conceivable—a Chinese maize breeder has cited a figure of five tons of grain for every additional ton of nutrient (Li). Indeed, much of the effect of chemical use may be indirect rather than direct: the Chinese have cited lack of time to apply (organic) fertilizers to second-crop rice, not lack of fertilizer per se, as a major cause of low yields. The labor saved through replacement of organic by chemical nutrient sources at such times can be applied profitably to other uses.

Western observers have commonly argued that the relative proportions of nitrogen, phosphorus, and potassium in Chinese chemical fertilizer production and imports have underestimated the need for phosphate and potassium (Erisman, USDA). However, this ignores the fact that organic fertilizers supply the latter in proportions which are high relative to plant requirements. Nevertheless, more attention is being given currently to phosphate production, which will benefit areas deficient in organic fertilizer sources and red-soil areas in particular, as well as legumes such as soybeans that are responsive primarily to phosphates.

Land Reclamation

Land reclamation has made little net contribution to China's grain production in the recent past, but current plans call for a roughly 12% expansion in cultivated acreage by 1985 (*FBIS*, 1 June 1978: E17); moreover, irrigation and urban construction plans have been shaped to insure a minimal amount of further encroachment on cultivated acreage. It appears that nearly half of the reclamation is slated for frontier areas, particularly in the northeast, and the remainder to come within regions where cultivation already is intensive. If so much potential for expansion exists, why has it not been previously exploited?

It seems that inadequate labor force and insufficient investment in mechanized cultivation techniques (perhaps also the insecurity of the Sino-Soviet border region) have held back the rate of reclamation on the frontiers. Moreover, the long-standing Maoist strategy of requiring each region to attain self-sufficiency in grain production directed the flow of investment funds elsewhere. By contrast, current plans call for concentrating investment on select regions designated as commercial grain bases. The frontier areas have fertile soil and tiny populations, hence with the provision of sufficient modern machinery and some preliminary irrigation and drainage work, these areas could provide an important commercial surplus of wheat, corn, and soybeans.

Reclamation in other areas will exploit marginal land too distant or low quality to be attractive to the collective decision-making process. It can be made attractive, however, by the simple device of allowing private reclamation and cultivation. Until this year, it is believed that the proportion of land under private cultivation was limited to 5% of the total. Recent decisions have raised the maximum to 15%, and encouraged the collective units to allocate wasteland to meet this quota (*FBIS*, 14 July 1978: E1).

Tractorization

Although the current drive to mechanize Chinese agriculture encompasses the introduction of a variety of "machines," including sprinkler systems and feed-processing machinery, the main thrust certainly is for more, better, and better-utilized earth-moving machinery. This so far has involved a complete reorganization of the agricultural machinery industry and distribution network, intended to raise efficiency and production levels through a hitherto unknown degree of specialization, cooperation, and standardization among producing units; to impose strict quality control and provide guarantees to purchasers; and to promote standardized part production and distribution, an improved service network, and better training for users.

In the Chinese view, tractorization will not release labor from agriculture. Rather, in the far north, it will permit expansion of cultivated acreage; in the north, freed labor will be employed in more intensive field management; in the south, labor employed in transport and plowing during periods of peak demand will be released for other tasks, permitting expanded multiple cropping and better field management. As a secondary effect, tractors have probably already begun to replace draft animals, freeing feed grain and fodder land for other purposes. Finally, China's farmland improvement program now ties down a 28 million full-time labor force, as well as a severalfold larger seasonal labor force. Its productivity can be increased greatly by provision of more earth-moving machinery.

Improved Efficiency, Management, and Incentives

The measures taken in recent months to improve efficiency, management, and incentives in agricultural production have exposed some major weaknesses of past policies, now attributed to the "Gang of Four" and their followers. For example, an emphasis on self-sufficiency in grain production in every region has led to lack of attention to areas with potentially large commercial surpluses, and to a general neglect of economic crops even where comparative advantage existed. This policy has been reversed with the designation of commercial "bases" for each crop, and encouragement of diversification according to economic criteria such as profitability. An above-average flow of industrial inputs and capital investment has been promised to such commercial bases.

Haste in promoting capital construction and rural small-scale industry has in the past led to diversion of labor away from crop production, often with little or no compensation to units supplying the labor. Current policy insists that full compensation be given, and that less labor be devoted to tasks unrelated to agricultural production.

Because collectivization has been treated as synonymous with progressiveness, in some areas private sector subsidiary activities were barely tolerated or suppressed, including private plot production of pigs, vegetables, and other products and rural free markets. Peasant rights in this regard now have been reinforced, and the scope of private activity expanded, so long as it does not compete for labor and raw materials with collective activity. The prices which the state pays for private products are also being adjusted, presumably to make them more comparable to free-market prices.

The political struggle at the center led to what is termed a "poor work style" at lower leadership levels; that is, undemocratic management of production units, various forms of petty corruption, and distribution practices which did not insure that increases in producer income resulted from increases in production. Undemocratic management also meant arbitrary planning of crop patterns and technological choices, in disregard of local conditions or opinion. Under current leadership, however, a major campaign is underway to promote a more democratic management pattern, eliminate corruption, and make sure that producing units are rewarded for increased production.

Conclusions

However admirable the progress made in Chinese agriculture over the past decades, the inability to raise permanently per capita production must have engendered great frustration among those elements of the leadership to whom modernization was most important. Major changes in economic policy are now taking place which hark back to the early 1960s, to a period during which Chinese grain production recovered and continued to grow at a rate of 5.5% annually through 1967, when, in the midst of the Cultural Revolution, the rapid advance was brought to a halt. Now, as then, the leadership has cast aside the major ideological constraints on growth. Now, even more than then, technological potentials can be and have been identified which may sustain a high growth rate. Provided that a political consensus behind these new policies and programs can be maintained, provided that "rectification" of the leadership structure right down to the grassroots can be carried out successfully, and provided that average weather conditions do not worsen, the Chinese leadership reasonably could hope to achieve their targets again. Even if they fall short, China's agricultural economy will continue to be characterized as self-sufficient and self-reliant.

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Editor's Note:
David Hopper, Jr., World Bank, was a discussant for this session but did not present a paper for publication.

Impact of Marketing Boards on Market Performance
(H. Bruce Huff, Agriculture Canada, Chairperson)

The Role of Marketing Boards in Stabilizing Commodity Markets

Larry J. Martin and T. K. Warley

An intensive effort has been made in Canada over the last two years to define and devise "a comprehensive national food strategy." In this yet-to-be-completed endeavor, two matters have been evident: (*a*) the enhancement of stability in the food system has emerged as a priority task of public policy and, (*b*) there has been growing uncertainty about the role of agricultural marketing boards. The two are interrelated because marketing boards are viewed as institutions potentially suited to furthering stability in the food system, and, by extension, in the broader economy.

Stabilization has long been a dominant theme of Canadian agricultural policy. Successive Canadian governments have approached the sustained transfer of income to farmers—the major objective of farm policies in most developed countries—with caution and moderation. Instead, a major purpose of Canadian agricultural policy has been to attenuate unplanned fluctuations in farm output, commodity prices, and farmers' incomes, and to transfer to the public sector a part of the private costs of such variation. The unprecedented turbulence in world and national commodity markets witnessed during this decade has validated the stabilization thrust of Canadian farm policy, and has motivated a deepening of the commitment to the stability objective.

The approach to stabilizing the food sector has been multidimensional. However, primary reliance has been placed on four programs. Stability in the dairy sector is achieved by a unique and complex set of programs involving market control, administered pricing, direct subsidies, and regulation of trade. Second, the Agricultural Stabilization Act provides floor prices (adjusted for changes in cash costs) for a wide range of crop and livestock products. Third, the Western Grain Stabilization Act guarantees that the net cash flow (gross receipts less cash costs) of grain growers in the Prairie region will not fall in the current year below the average of the previous five years. Fourth, and most pertinent to this paper, there are the market control plans operated by a variety of national and provincial agencies. This set of programs has three features in common: (*a*) the programs are directed at the farming component of the food system; (*b*) they are designed to reduce variation in the prices (or gross margins) of commodities on an industry-wide basis; and (*c*) they are asymmetric insofar as they are concerned predominantly to limit only down-side market price fluctuations.

A distinguishing feature of institutional arrangements in the Canadian food system, and of Canada's farm and food policy, is the extent to which the first-stage marketing of farm products is controlled by mandatory agencies. Furthermore, the direction of development of public policy has been toward the extension of mandatory centralized marketing. The number of marketing boards and their share of farm cash receipts has risen from 66 and 13% in 1958 to 100 and 60% at the present time (Agriculture Canada). National agencies have been created to coordinate the activities of provincial marketing boards for some commodities. And some boards have been granted additional powers that strengthen their influence on commodity markets.

The objectives that farmers pursue through their marketing boards are income stability,

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The authors were assisted in the empirical analysis by Michael Farrow and Carolyn Scott. An expanded version of the paper is available from the authors.

income enhancement, economic security, equity in their access to and their treatment in markets, and control of their economic destinies. To attain these objectives, marketing boards have been given wide ranging powers to regulate production, pricing, and marketing practices. These powers are used in two broad ways (Forbes). First, virtually all boards seek to expand markets and to improve their operational and pricing efficiency. Second, some boards try to improve the farmer's position in the market more directly by such practices as restricting entry into production, controlling long-run industry output, neutralizing short-run surplus supplies, unilaterally setting selling prices for raw products, bargaining collectively on prices and terms and conditions of sale, allocating product to differentiated markets, and controlling the rate of flow of product into consumption. The ability to do several or all of these things provide the influence that boards have on market stability.

Boards with supply management and/or price setting powers have been accused of misusing their powers in ways which, *inter alia,* erode competitive efficiency and generate inequities in income distribution. An important component of the response to these charges has been to emphasize the positive contribution that their practices make to stability. Specifically, the boards' objective of enhancing stability has been invariably and explicitly invoked to justify their creation and their activities; much has been made of the proposition that the attainment of this objective promised benefits to all food system participants; and it has been claimed that benefits secured from this source should be counted against any negative effects of their programs.

Interestingly, the claim that marketing boards do enhance stability has not been extensively tested.[1] It is to that, that we now turn.

Empirical Analysis

To test the hypothesis that Canadian marketing boards have been successful in reducing market instability, the variation in four market variables—industry output, producer price, industry gross revenue, and consumer price—was examined empirically for five commodities—pork, tobacco, chicken broilers, turkeys, and eggs. The marketing of each of these five commodities is regulated by a producers' marketing board,[2] and the degree of market control increases from first to last over the sequence in which they are listed.

For each commodity except tobacco, monthly data were obtained and each set of data was broken into two time periods. The second period began when some major institutional development in marketing board arrangements occurred which represented a greater degree of market control, and thereby of the potential to influence market stability.

Data for the same variables, commodities, and time periods were obtained for the United States and compared with those for Canada on the assumption that these contiguous markets would otherwise behave in a similar manner in response to exogenous market forces.

For each commodity and time period, means and standard deviations of the year-to-year percentage changes in monthly producer price, output, and industry revenue were calculated. This procedure eliminates any inherent seasonality in the series and provides measures of variation resulting from both trend and variations around trend. The stability of prices facing consumers was measured by calculating the means and standard deviations of both the year-to-year and month-to-month percentage changes in retail prices. All means and standard deviations were subjected to t- and F-tests, respectively, to determine whether significant differences existed between periods and countries.

Because tobacco is produced seasonally, only annual data were used. Second, because there have been no substantial changes in board policies influencing stability since 1960, only one time period was analyzed. Third, retail prices for tobacco products were not examined because of their tenuous relationship to raw leaf prices. Finally, because the U.S. market for flue-cured tobacco is strongly controlled, Canadian data were compared with those for the world market, the U.S. export price being taken as a proxy for the world price.

A brief description of the types and degree of market control exerted by each board is presented below. This is followed by a presentation of means and standard deviations of the percentage changes in each variable (table 1) and of the inferences drawn.

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[1] The subject was tentatively addressed in several reports of the Food Prices Review Board in the period of its existence, 1974–76. Loyns drew extensively on this work and contributed additional material.

[2] Grains and industrial milk were excluded from the analysis because the major direct influences on the performance of the markets for these commodities are the policies of the federal government and its agencies rather than the practices of producers' marketing boards.

Pork

The provincial pork boards do not have direct control over either production or prices and only modest tariff protection is provided against imports. Only Ontario and two of the Maritime provinces in eastern Canada have pork marketing boards, but data for all of eastern Canada are included in the analysis. Although no significant changes have occurred in marketing board policies since 1965, the data series for pork are divided into two periods (1965–71 and 1972–77) to provide a comparison with the other commodities.

Four inferences may be drawn. First, less variation occurred in Canadian than in U.S. pork supply after 1971, while the rate of increase in supply fell in both countries. Second, in the later period less variation has existed for eastern Canadian producer prices than for the United States. However, the rates of increase and the variability of prices increased in both countries after 1971. Third, the rates of increase and variability in revenue increased for both countries after 1971. Finally, the rate of change and variability of retail pork prices increased for both countries after 1971 and Canadian retail prices were more variable than retail prices in the United States.[3]

Flue-cured Tobacco

The Ontario marketing board controls output with production quotas. There is no quantitative control of imports, but there is a 30¢ per pound tariff on stemmed tobacco.

The analysis shows that the variability of both production and revenue in Ontario has been greater than in the world market, but that there has been no significant difference in the variation of price.[4]

Chicken Broilers

Provincial marketing boards for broilers were introduced in Canada beginning in the early 1960s. All provinces were under board control by 1971. To reflect this situation, the data series are divided into two periods (1965–71 and 1972–77). The later period reflects considerably more market control on the part of the boards. The largest producing province (Quebec) came under board control in 1971. Thereafter, Ontario and Quebec, which together account for about 75% of Canada's production, entered into a market share agreement under which changes in output in the two provinces are made in concert. Board decisions among all the provinces are now informally coordinated.

The provincial broiler boards establish minimum prices based on production cost formulas. They then establish production quotas in an attempt to produce only the output that they anticipate can be sold at these prices. Because of the difficulty in forecasting accurately, inventories play a major role in clearing the broiler market. There are no quantitative restrictions on imports, but a 12.5% tariff, with a minimum of 5¢ per pound, is imposed on eviscerated imports.

The post-1970 period for broilers was further segmented to focus on the period 1974–1977. This was done because the U.S. price freeze in 1973 had substantial impacts on prices. Tests for significant differences between time periods were performed by comparing the statistics from 1966–70 with those from both 1971–77 and 1974–77.

Five inferences emerge from the analysis. First, no change in the variation in Canadian supply occurred after the move toward more marketing board control in 1971. However, the rate of increase in Canadian supply declined. Second, total availability of product (production plus inventories) in Canada has been more variable than in the United States and no change in variation occurred after 1971. The rate of increase in availability declined after 1971. Third, variation in Canadian producer prices declined after 1973, while producer prices in the United States fluctuated even more widely than they had before 1971. Fourth, the variation in Canadian revenue from broilers was smaller relative to the United States after 1971, but was not less variable than it had been in Canada before 1971. At the same time, the rate of growth in Canadian revenue declined after 1973. Finally, the variation in year-to-year changes in Canadian retail prices were greater after 1971 than before, and the variation of Canadian retail prices was not different than for the United States. Moreover, the rate of increase in retail prices for Canada was greater after 1971. By contrast, after 1974, variations in month-to-month changes in Canadian retail prices became smaller than in the United States and smaller than before 1971.

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[3] Retail price statistics for Canada do not exist as they do for the United States. The Canadian series used here is for Boston Butt. Use of retail prices for only one cut may be responsible for the greater variation observed in Canadian data.

[4] Very little change in yield has occurred over time in Ontario. Variations in production closely reflect those in quota allocation.

Turkeys

Both provincial boards and a national marketing authority exist for turkeys. The provincial boards establish prices and production in much the same manner as is done for chicken broilers. Import tariffs are established at the same levels as for broilers but, with the creation of a national marketing board in 1974, an import quota was introduced.

The time series for analysis is divided into two periods (1965–73 and 1974–77) to reflect the greater market control obtained by the formation of the national authority in 1974 and the simultaneous introduction of quantitative restrictions on imports. Because of the extreme seasonality in production, only the last five months of producer prices, production, and revenue for each year are included in the analysis.

The analysis supports the following inferences. First, the extent of fluctuations in Ontario's turkey production did not change after formation of the national marketing authority in 1974. Moreover, fluctuations in Ontario's production have been greater than for the United States. Second, while fluctuations in producer prices were reduced for both Ontario and the United States after 1974, the fluctuations in Ontario were smaller than for the United States after 1974. Third, while revenue was less variable in both Ontario and the United States after 1974, revenue in Ontario was more variable than in the United States. Fourth, both the rate of increase and variation in the annual change in retail prices were greater in Canada than in the United States after 1974. Finally, month-to-month variability in Canadian retail prices was greater than for the United States.

Eggs

Provincial egg marketing boards were established during the 1960s. A national agency was instituted in 1973 and quantitative import controls were imposed simultaneously. Accordingly, the data were divided into the periods 1965–72 and 1973–77. Currently, the national board establishes production quotas for each province. The provincial boards in turn establish prices for table eggs, based on production cost formulas, and allocate quota to individual producers within the province. If eggs produced within provincial quotas can not be sold on the table market, they are sold to the national agency which sells the "surplus" eggs to the processing market for less than acquisition prices. To finance the "losses" from surplus disposal, a levy is deducted from producer prices. These levies were available only from 1975. Hence producer prices and revenues net of levies were analyzed for the period 1975–77.

The analysis points to the following inferences. First, no change occurred in variations in Ontario's production after 1973. Furthermore, it has been consistently less stable than production in the United States. Moreover, the rate of change in Ontario's production relative to the United States fell after 1973. Second, while the variation in producer price declined in both countries after 1973, the variation in producer price for Ontario was not significantly different than in the United States. At the same time, the rate of increase in Ontario producer prices was higher than for the United States after 1973. Third, variations in Ontario revenue were not less than for the United States after 1973. However, the rate of increase in revenue for Ontario was higher than for the United States. Finally, Canadian retail prices were less variable after 1973 than previously and than U.S. prices during the second period.

Conclusions

Even the most casual student of stabilization policy and of producers' marketing boards will be conscious of the limitations of the foregoing analysis.

Any partial analysis of the impact of marketing boards on a single criterion of market performance must be suspect, the more so when there is more than a suspicion that enhancing market stability is a second order priority of most boards. Second, we have done no more than measure the dimensions of observed variation of a few coefficients in selected commodity markets in which boards are present

Table 1. Means (μ) and Standard Deviations (S.D.) of Year-to-Year Percentage Changes in Production, Producer Prices, Revenue, and Retail Prices for Pork, Tobacco, Chicken Broilers, Turkeys, and Eggs

	Production		Production and Inventories		Producer Price		Revenue		Retail Prices (Year to Year)		Retail Prices (Month to Month)	
	μ	S.D.	μ	S.D.	μ	S.D.	μ	S.D.	μ	S.D.	μ	S.D.
Pork												
1965–71:												
Eastern Canada	6.13	10.86	N.A.	N.A.	1.61	20.41^{b}	2.88	15.27	.29	16.56^{b}	.17	3.29
United States	4.80	10.80	N.A.	N.A.	.79	25.46	3.30	17.17	1.99	13.08	.33	2.77
1972–77:												
Eastern Canada	1.49^{a}	9.21^{b}	N.A.	N.A.	13.57^{a}	27.67^{a,b}	13.27^{a}	20.39^{a}	11.62^{a}	25.62^{a,b}	1.12	6.43^{a,b}
United States	.85^{a}	14.71	N.A.	N.A.	14.17^{a}	34.80^{a}	9.38^{a}	23.03^{a}	10.45^{a}	20.51^{a}	.85	4.48^{a}
Tobacco												
1965–71:												
Ontario	1.83	19.58^{b}	N.A.	N.A.	4.56	9.41	6.27	22.00^{b}	N.A.	N.A.	N.A.	N.A.
World	2.76	6.00	N.A.	N.A.	5.71	7.20	8.90	12.38	N.A.	N.A.	N.A.	N.A.
Chicken Broilers												
1965–70:												
Canada	11.29^{b}	8.10	10.74^{b}	13.00^{b}	−0.78	7.10^{b}	10.36^{b}	10.73	0.49	6.04	0.03	3.81
United States	6.87	6.71	6.87	7.45	−1.52	10.93	5.05	11.91	1.13	7.10	0.17	3.05
1971–77:												
Canada	3.96^{a}	8.13	4.32^{a}	11.12^{b}	10.72^{a}	16.88^{a,b}	14.87^{a}	17.82^{a,b}	12.73^{a}	13.65^{a,b}	0.99^{a}	2.74^{a,b}
United States	4.31^{a}	7.90	4.11^{a}	7.54	13.19^{a}	32.53^{a}	17.04^{a}	30.06^{a}	8.61^{a}	23.12^{a}	0.73	8.23^{a}
1974–77:												
Canada	4.48^{a}	9.74	3.83^{a}	14.05^{b}	0.78	5.42^{a,b}	5.14^{a}	9.79^{b}	5.38^{a}	10.77^{a}	0.55	2.57^{a,b}
United States	5.63	8.49	5.13	7.91	4.04^{a}	17.82^{a}	9.25	16.73^{a}	3.09	11.94^{a}	0.0009	3.40
Turkeys												
1965–73:												
Ontario	2.97	24.48^{b}	N.A.	N.A.	10.29	30.20	14.25	44.90^{b}	7.83	13.78	0.85	4.29^{b}
United States	1.92	9.80	N.A.	N.A.	11.34	30.12	12.79	28.95	6.03	14.67	0.61	2.38
1974–77:												
Ontario	7.99	23.48^{b}	N.A.	N.A.	5.77	8.30^{a,b}	14.76	28.24^{a,b}	5.63^{b}	11.08^{b}	0.40	4.62^{b}
United States	3.64	11.47	N.A.	N.A.	9.28	18.22^{a}	12.33	16.81^{a}	.46	7.72	−0.17^{a}	2.64
Eggs												
1965–72:												
Ontario	3.47^{b}	8.20^{b}	N.A.	N.A.	3.53	30.94^{b}	5.67	27.51^{b}	1.17	16.03	0.70	7.82
United States	0.86	3.11	N.A.	N.A.	1.99	20.56	2.26	18.67	1.22	16.21	0.44	7.16
1973–77:												
Ontario	1.10	8.03^{b}	N.A.	N.A.	6.30^{b}	15.4^{a}	7.40^{b}	16.87^{a}	4.99	10.69^{a,b}	0.57	3.57^{a,b}
United States	−0.63^{a}	2.20^{a}	N.A.	N.A.	0.57	15.0^{a}	−0.14	14.59^{a}	2.73	12.69^{a}	0.28	8.13
1975–77: (net of levies)												
Ontario	N.A.	N.A.	N.A.	N.A.	9.22^{b}	13.41^{a}	12.88^{b}	11.77^{a}	N.A.	N.A.	N.A.	N.A.
United States	N.A.	N.A.	N.A.	N.A.	2.04	13.83^{a}	2.08	12.88^{a}	N.A.	N.A.	N.A.	N.A.

[a] Indicates significant differences between time periods within countries; means were tested for differences at the 90% probability level; standard deviations were tested at the 95% probability level.

[b] Indicates significant differences between countries within time periods.

and presumed to have some influence. The multiple factors that cause and temper market fluctuations have not been explored, and *ex post* one cannot know what the pattern of variation would have been in the absence of the boards, albeit that the comparisons of experience in the Canadian and U.S. markets where different institutional arrangements prevail may be suggestive. Third, the national supply management plans for eggs and poultry meats have been in existence for less than five years and there is a real possibility that the stabilization benefits of the activities of the boards for the commodities may improve as the market control schemes attain maturity. Fourth, we know nothing of the linkages between fluctuations in the variables examined and changes in the probability density functions of the expectations of market participants pertaining to these variables and others to which they are related, or for which they are proxies. Fifth, without knowing the priority rankings that are attached to each variable and in the absence of objective performance norms, there is no means of knowing whether the observed variation was planned and optimal, or uncontrolled and excessive, or too small. Finally, the measurement of variation, even in a wider range of variables than considered here, is merely a starting point. The real interest lies in establishing the consequences of changes in variation on (*a*) the expectations and behavior of firms and households, which is the level at which investment and consumption decisions are made; (*b*) the resultant performance of the food sector and the economy in terms of allocative efficiency, progressiveness, and macro-stability; and (*c*) the distribution of the benefits and costs of stabilizing the economic environment. These matters, which are the concerns of policy, are suggestive of the types of studies to which we must progress if the utility of professional research on instability is to be commensurate with its importance as a subject of public policy.

As to the conclusions to be drawn from this initial analysis on the issue of whether producers' marketing boards enhance market stability, the only verdict which is supportable at this stage is that found in Scottish jurisprudence, "not proven." If this result is confirmed by more detailed analyses it will be an important finding, because we would argue that if marketing boards do not deliver stabilization benefits that are unequivocal, large, and widely distributed, then, at a minimum, society should avoid over-valuing this aspect of the case for boards and their practices.

Indeed, we are inclined to go further and suggest that in the public policy debate about boards, rather less attention should be paid to their stabilization effects and rather more to other criteria of board performance. Many Canadian producers' marketing boards are regional in scope and, like the pork boards, have few powers to influence market stability. They do other socially useful things, and their inability to stabilize markets should not be counted against them. By contrast, the stabilization results attributable to boards with supply management powers, which do have the potential for influencing the stability of important market variables, seem not only limited but less consequential than the alleged malignant effects of their practices. For even the most ardent advocates of marketing boards have found it difficult to refute the charge that the supply management boards have been permitted to use their powers in ways which exacerbate inflation, balkanize the national market, nurture a "Fortress Canada" posture, lower efficiency in production and marketing, provide excessive returns to resources, generate inequities in income distribution, and erode entrepreneurial freedom. Furthermore, it is apparent that any efficiency benefits that flow from these boards' stabilizing practices are partially offset, and perhaps overwhelmed, by those features of the supply management boards which shift supply functions to the left, i.e., the capitalization of economic rents into burdensome costs, underutilization of capacity, and attenuaton of the imperatives of continuous innovation and progress provided by the uncertainties of competitive markets.

The tradeoff between stabilization benefits that seem "spotty," and uncertain at best, and the demonstrable worsening of competitive efficiency and impairment of equity that are attributable to the supply management boards does not strike one as being immediately favorable to Canadian society at large, or ultimately, to Canadian farmers themselves.

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Public Intervention and Producer Supply Response

Gordon C. Rausser and D. Peter Stonehouse

For market behavior and policy analysis as well as for forecasting, the concept of supply response is crucial. Cochrane emphasized dynamic supply relationships, the effects of technical change on response, and the potential asymmetry in farmers' response to increasing and decreasing prices. More recently, the importance of risk has been emphasized in the specification of supply response relationships (Rausser; Just 1974, 1975; Hildreth). Houck and Ryan introduced explicit exogenous governmental policies, namely the "effective" support price. This work has been extended by the inclusion of future prices as proxies for expected prices, which presumably reflect the influence of both governmental policies and private sector markets (Gardner). These studies, along with the work surveyed in Tomek and Robinson, have provided the empirical basis and direction for further research on supply response. Nevertheless, it is the contention of this paper that much of this research provides a grossly inadequate foundation for useful policy analysis as well as forecasting. Most conspicuous is the lack of progress in modeling effects of government intervention on producers' supply response, the behavior of government policy makers, and reactions and feedback effects between the private and public sector.

Government Intervention

The demand for and propensity of governments to intervene actively in agricultural and food systems is well known and need not be elaborated (Brandow). Such intervention assumes many forms; in some countries it is the national government that actively intervenes in the hopes of achieving self-sufficiency; in other countries marketing boards or marketing orders attempt to influence private sector behavior; in still other countries, especially planned economies, governments directly intervene in both the domestic systems and international trade.

The distortions arising from governmental intervention and international trade have been documented on numerous occasions. The effects of these various forms of governmental intervention are pervasive, regardless of whether they assume the form of income supports, supply controls, or barriers to trade. Many of these policies have the direct influence of transferring risk from individual producers to taxpayers or consumers, while others redistribute the risk within the private commodity system among the various participants along vertical commodity chains. Surely all of these policies distort the traditional market price signal mechanism to producers. Hence, the producers, in effect, become shielded from the full impact of price variations and learn to respond not only to market price variables but to governmental policy variables as well. Once the relationship between governmental policies and risk in the private sector is recognized, we must proceed one step further and introduce the notion of a public good. In particular, a public good by definition allows "equal consumption" by all agents. Hence, if governmental intervention alters the level of total risk within the system or redistributes that risk by lowering the amount of risk faced by all farmers, then we have the classical definition of a public good effect. Of course, there is a difference between the consumption of such a good and the utility various farmers derive or equivalently an "unequal ability to consume the public good" (Rausser and Riboud).

One of the principal incentives for governmental intervention is the basic instability of the private sector. This instability emanates from the qualitative characteristics associated with yield uncertainties, highly inelastic de-

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mand and supply, along with the other structural characteristics of agricultural systems. Conventional wisdom has long held the view that the resulting unstable market can and should be stabilized by conscious economic policies of national governments. As Lindbeck has pointed out, however, such recommendations neglect instability and imperfections in the political-administrative system. Lindbeck argues that the most reasonable approach is to treat explicitly instabilities and imperfections in both market and political-administrative systems. This view is substantiated by the historical performance of governmental intervention in domestic agricultural commodity systems. Certainly, differences between various short-term economic forecasts often depend less on the internal functioning of the private sector than on different assumptions of future policies.

In the above setting, an important issue that arises in the specification of agricultural supply response relationships pertains to the relevant decision-making or behavioral units. In the context of short-run supply response, previous research would strongly suggest that the relevant behavioral units are the producers themselves. At most, the work of Houck and Ryan along with others deals only with conditional behavioral responses on the part of the producers where the conditioning elements relate to governmental policy. Given the feedback relationships among government policy makers and producers, however, it is quite possible that governmental policies which appear beneficial in the short run could well prove in the long run to be undesirable. Moreover, the very nature of economic theory leads us to expect that the conditional behavioral relationships of producers will change drastically over time as a result of governmental intervention. For example, Lucas has argued that a change in policy will result in a change in the environment facing economic units. Given rationality, this will result in shifts of the equations representing the behavior of such units. This source of parameter instability can only be avoided by reasonably accurate measurements of expectation formation patterns and dynamic responses, a dubious hope at best.

In the long run, for policy analysis and particularly for forecasting purposes, it would seem essential to endogenize both the private and public sector behavior related to supply response. Little empirical evidence, unfortunately, has been accumulated on quantifying the behavior of governmental administrators. Nevertheless, our posture in the specification of these relationships should be "positive" rather than "normative." As Lindbeck (p. 11) notes, an eclectic approach is needed which combines proxies for "electibility" with more idealistic variables such as producers' and consumers' welfare in the criterion function of the governmental decision makers. Such a "positive" approach is entirely consistent with recent advancements in the theory of economic regulation (Stigler, Peltzman). Much of this literature is concerned with wealth redistributions through the regulatory process. In Peltzman's framework, the governmental decisionmaker or regulator arbitrates among the interest groups in seeking to maximize his majority, i.e., his probability of election, reelection, or reappointment.

Alternative Frameworks

Clearly, the conventional neoclassical formulation will not do as a framework for quantifying the interaction and feedback effects between public and private sectors. The typical use of expected prices and opportunity costs as explanatory factors for supply response is predicated on competitive markets and fails to account for government policy variables that distort and, in some instances, supplant the market signalling mechanisms.

A partial solution is provided by what might be referred to as the modified conventional formulation. Here, the neoclassical paradigm is essentially maintained while the additional effects of risk or exogenous governmental intervention are allowed. For instances in which governmental intervention results in only mild distortions of market signals and only short-run impacts are under examination, this modification is a reasonable approach. For the general case, it should be recognized that governments do not operate in a vacuum, but are an integral and essential part of the supply-response mechanism.[1] Attempts must be made to explain and provide forecasts of governmental responses and producers' influence on government, as well as producers' responses to market forces, risk factors, and governmental intervention. To operationalize such attempts, the effects of governmental intervention on risk and wealth distribution must be conceptualized and some unconventional empirical methods will be needed.

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[1] In the context of international grain markets, a step in this direction has been provided by Abbott. He empirically estimated a "modified reduced form" for private sector behavior. In particular, private sector excess demand relationships are estimated whose qualitative parameter effects depend not only on private but as well on public sector behavior.

Government Intervention and Risk

The specification of the structural representation for governmental behavior depends upon the form and shape of governmental intervention. Alternative forms of government intervention will result in different influences on the level and distribution of both wealth and risk within the commodity system. For example, a buffer stock policy transfers market risk from the private sector to the public sector and often redistributes risk within the private sector. Processors and assemblers of feed grains generally face less "relative risk" on quantity, quality, and price dimensions under buffer stock schemes, that is, relative to the total level of risk in the system.

The reduction and/or redistribution of market risk within the private sector, however, is obtained at the price of augmented institutional risk. In particular, much of the price risk in the private markets is supplanted by institutional sources of risks. These risks are especially apparent when producers attempt to anticipate the direction and magnitude of government policy variable changes. To be sure, the level of market risk can be influenced (reduced) by a number of policies which correspondingly augment the level of institutional risk.

Empirical Methods

The structural specification of both public and private sector behavior also requires the use of unconventional empirical methods. These methods include parameter variation, qualitative econometric, and market disequilibrium estimation procedures. Parameter variation specification and estimation procedures recognize the Lucas observations noted earlier, the abstract nature of econometric models and their inherent misspecifications, and the need in policy analysis and forecasting for results that are tractable and interpretable (Rausser and Mundlak).[2] These methods allow models to be specified as linear in the variable space but nonlinear in the parameter space. They treat parameter effects as random and nonstationary. In the context of the private sector, the probability distributions on the parameters depend upon market force variables as well as governmental policy variables. A similar distinction exists for the public sector.

Qualitative econometric procedures subsume disequilibrium methods and deal directly with noncontinuous endogenous variables. These procedures have been surveyed in the fall 1976 issue of the *Annals of Economic and Social Measurement*. They should be useful in the quantification of behavioral relationships for the public sector, especially where policies assume the form of discrete states whose probabilities are of particular interest. For quantification of private sector behavior, it has been demonstrated that qualitative econometric estimates of market demand and supply relationships for wheat are quite different than conventional estimates (Rausser and Riboud). The former estimates explicitly recognize that price support schemes truncate the complete probability distributions assumed by commonly employed statistical methods and thus Tobin-like estimation methods are required.

Market disequilibrium procedures are needed when the exchange occurs at "false" prices, i.e., prices which do not clear the market. For the private sector representation of supply response and demand, this requires the substitution of the typical market-clearing identity by a condition on quantity exchanged, viz., that the quantity exchanged is the minimum of supply and demand (Fair and Jaffee). In the case of price supports, without public demand for inventories (or buffer stock schemes), such disequilibrium representations are clearly appropriate. For quota schemes of all types, again we find the potential for disequilibrium specifications. To the extent that demand is unsatisfied at a nonmarket clearing price (exogenous or endogenous to the private sector), the quota will prevail. On the other hand, if demand falls short of the quota, buyers will dictate the quantity exchanged.[3]

Illustrative Application

Many of the above issues can be illustrated in the context of the Canadian dairy industry.

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[2] The major sources of misspecifications include omitted variables, data limitations and proxy relationships, aggregation, inappropriate functional forms, and the like.

[3] It should be noted that disequilibrium representations and their corresponding "mixture" or structural equations can be approximated by parameter variation methods. For further details, see Rausser and Mundlak.

Here the degree of interaction between milk producers and regulatory agencies is significant and feedback effects are well established. The regulatory agencies respond to changing market conditions, including producers' responses to policy variables, by continually adjusting the policy instruments at their disposal. Moreover, the forms of intervention have virtually eliminated market price risk and the principal source of risk is institutionally oriented. Producers respond to this risk as well as to distorted market signals. In this setting, an exogenous treatment of governmental policy variables will not suffice. Instead, a structural specification requires behavioral equations for both producers, private markets, and the regulatory agency (see Stonehouse and Rausser for a more complete treatment).

Government intervenes in the dairy industry principally through supply control instruments and income support measures. Supply control instruments include market-sharing quotas and penalties for exceeding individual quota levels. Income support measures include direct subsidies to milk producers and offers to purchase surplus butter and skim milk powder at guaranteed minimum prices. Price supports at the processed product level are designed to permit higher milk prices to be passed on to producers by processing plants. Subsidies and support prices are used as joint policy instruments to attain target returns for milk producers. Producer responses to target returns variations are taken to be changes in herd size, percentage of cows milked, and average milk yield per cow (through altering quantity and composition of feeds). Sufficient quotas are issued in the hope of achieving an equilibrium of supply and demand at the specified price support level. To be sure, this policy scheme is in contrast to either an open-ended income support scheme or a supply control system with no price intervention.

Endogenous Policy Variables

Due to space limitations, preliminary results are offered in this paper only for the equations representing the important government policy variables. The empirical results for the policy block are presented in table 1. These results are indeed encouraging, the degree of explanation is quite satisfactory, and the estimated sign effects are in general correspondence with a priori reasoning.[4] Note that one of the most important endogenous variables is Y_7, the aggregate market-sharing quota. Each explanatory variable entering this equation plays a specific role; net target return is a proxy for producers' welfare; assumed processing margin represents processors' interests; change in government stocks and the government deficit are proxies for taxpayers' interests; the consumer price index is a proxy for consumer concerns; lagged quotas represent the government's major reference point. The estimated effect of each of these variables corresponds with the presumed qualitative effects except for the consumer price index. For given price supports above "market equilibrium prices," the payoff to producers is increased by larger quotas and thus producer groups can gain by forming effective coalitions to increase quotas. Similar reasoning holds for processors who gain from handling larger volumes. As government deficits increase, taxpayers have incentives to lobby for reduced quotas. Likewise, larger inventories imply greater treasury exposure and thus a desire on the part of government to decrease the quota. In the case of consumer welfare interests, the price index proxy should tend to augment quotas. However, consumer interests are diffuse and no effective coalition is observed. Hence, the estimated negative effect appears to reflect government's attempt to balance supply and demand through the imposition of quotas in an inflationary economy.

Conclusion

The specification of behavioral equations for both private and public sectors allows comprehensive long- and short-run forecasts to be made not only of supplies, demands, and prices, but also of the important governmental policy variables. Hence, the basic proposition of this paper is that for agricultural commodity markets which exhibit a high degree of governmental intervention, specification of the correct structural form depends on responses of both the private and public sectors, together with their feedback effects. The preliminary empirical results obtained in this paper support the views that acceptable representations of behavioral equations for the public sector can be captured.

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[4] The policy block was estimated by OLS and TSLS. The results obtained for each of these estimation methods were basically equivalent.

Table 1. Empirical Results for Endogenous Dairy Policy Behavioral Equations

	$Y_{1(t-1)}$	Y_1	Y_2	Y_3	Y_6	$Y_{5(t-1)}$	$Y_{7(t-1)}$	Y_7^{-1}	$Y_{8(t-1)}$	Y_{11}	Y_{13}	$Y_{14(t-1)}$	$\Delta Y_{14(t-1)}$	$Y_{15(t-1)}$	$Y_{15(t-2)}$
Y_1	0.816 (0.0571)														
Y_2		0.0656 (0.0122)			0.246 (0.0908)					−0.111 (0.0468)			1.81E-04 (1.72E-04)		
Y_3		0.0770 (0.00289)			0.0760 (0.0338)					−0.0586 (0.0115)					
Y_4				0.772 (0.0363)				0.772 (0.0363)							
Y_5						0.663 (0.120)						0.0163 (0.0103)		9.97E-03 (3.42E-03)	
Y_6		0.138 (0.129)													
Y_7					37.9 (20.2)		0.182 (0.149)				18.5 (3.80)		−0.0486 (0.0481)		
Y_8		0.535 (0.104)							0.413 (0.116)						
Y_9			−42400 (13900)									187.0 (44.2)			
Y_{10}				−15.5 (9.88)										0.0171 (0.0176)	0.0190 (0.0169)

Identities: $Y_{11} = Y_1 - (4.2Y_2 + 8.0Y_3) + Y_6$, direct producer subsidy; $Y_{12} = Y_1 - Y_4$, net target return on industrial milk; $Y_{13} = Y_1 - Y_{11} - Y_5$, penalized producer return for over-quota milk; $Y_{14} = Y_{14-1} + Z_2 - Z_3 + Y_9 + Z_4 - Z_{4-1}$, governmental butter stocks; $Y_{15} = Y_{15-1} + Z_5 - Z_6 + Y_{10}$, governmental skim milk powder stocks; Z_2 – butter production; Z_3 – butter retail sales; Z_4 – commercial stocks butter; Z_5 – powder production; Z_6 – retail and industrial sales; Z_7 – commercial stocks powder; Z_8 – domestic disappearance of fluid milk; D_1 – seasonal dummy – 1st quarter; D_2 – seasonal dummy – 2nd quarter; D_3 – seasonal dummy – 3rd quarter. Y_1 – gross target return on industrial milk; Y_2 – support price for butter; Y_3 – support price for skim milk; Y_4 – in-quota holdback from direct subsidy; Y_5 – penalty on milk produced over-quota; Y_6 – assumed processing plant margin; Y_7 – aggregate market sharing quota; Y_8 – declared farm price of fluid milk; Y_9 – net exports of butter; Y_{10} – net exports of skim milk powder; X_1 – consumer price index; X_2 – exchange rate (Can. \$ per U.S. \$); X_3 – government (internal) deficit; X_4 – world price of butter; X_5 – world price of skim milk powder; X_6 – dairy feed cost; X_7 – short term commercial interest rates.

Table 1 (continued)

	$\Delta Y_{15(t-1)}$	Z_8	X_1	X_2	X_3	X_4	X_5	X_6	X_7	D_1	D_2	D_3	Const.	$\bar{R}^2$	S.E.R.
Y_1			0.0541 (0.0170)					0.0482 (0.0104)		−0.113 (0.0644)	0.299 (0.0755)	0.0506 (0.0784)	0.184 (.057)	0.996	0.150
Y_2						0.175 (0.0754)							0.225 (0.0323)	0.980	0.023
Y_3	−4.05E-05 (3.46E-05)						0.115 (0.0162)						−0.163 (0.0127)	0.998	0.008
Y_4					4.66E-05 (2.87E-05)		−0.772 (0.0362)						0.121 (0.0157)	0.947	0.314
Y_5					1.48E-03 (3.09E-04)								−0.0713 (0.0446)	0.936	0.0456
Y_6			3.22E-03 (1.02E-03)										−0.0471 (0.967)	0.830	0.999
Y_7			−1.90 (0.393)		−3.20E-03 (2.60E-03)								142 (28.7)	0.892	6.101
Y_8		1.86E-06 (7.30E-07)											−1.22 (0.922)	0.994	0.173
Y_9				35700 (23300)	7.84 (2.08)	−42400 (13900)			814 (663)	−2310 (2960)	12500 (2990)	8790 (2520)	−41000 (24500)	0.641	4.51E-03
Y_{10}				−1.40 (15.4)	−6.51E-04 (14.9E-04)		−15.5 (9.88)			−1.45 (2.08)	−2.72 (1.49)	−2.00 (1.36)	6.64 (15.7)	0.271	2.34

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Discussion

L. T. Wallace

The Martin-Warley paper tests the ability of five Canadian marketing boards (pork, flue-cured tobacco, broilers, turkeys, and eggs) to reduce market instability by checking four market variables: industry output and gross revenue, and producer and consumer prices for two time periods—one before and one after a significant institutional change toward more market control by the boards. A control group is comprised of U. S. data for the same time periods. Relevant statistical tests were used. Their conclusions were that the ability of market boards to produce market stability was highly suspect and certainly not to be assumed as one of their inherent characteristics.

Despite their modest claims of inadequate analytical treatment and inability to show definitely that boards do stabilize markets, their paper is a useful and intelligent exposé of one of the basic problems dealing with government (political) intervention in the food system. The boards, in general, have power to control production, producer entry, and farm prices—yet they seem to fail in achieving their main task of guiding the food system effectively. They appear to succeed in their function of providing adequate farm incomes if firm volume is great enough, yet they seem to ignore the impact of their actions on consumer food budgets and inflation. It is to the authors' credit that they point out these problems, and, moreover, suggest that the next round of inquiry about boards should be in their operational structures and roles rather than in measuring a single performance criterion.

Several questions could be raised in reviewing the authors' paper, the key one being whether or not there are feasible alternatives (politically and economically) to marketing boards if their demonstrable performance according to well-defined policy ends is questionable. Perhaps the situation has deteriorated to such a degree that flexibility is nil. The options may be simply to minimize whatever negative consequences that can be identified, or do away with boards entirely.

However, a third alternative to the existing institutional structure would be to analyze what might happen if the Canadian boards were to follow a pattern similar to the State of California marketing orders. These board members are elected from the industry, meetings are monitored by economists from the California State Department of Food and Agriculture, and board actions are subject to review by that department's director who has final authority over operations of the board. Essentially, boards are concerned with advertising, promotion, some research, and data collection; they do not set prices, nor do they now practice supply-control programs. They are funded from commodity-wide assessments set by referendum of growers or grower/handlers for a commodity.

Corollary questions raised by Martin-Warley are whether Canadian boards still operate in the broad public interest for which they were initiated. The answer to this depends in large measure on the political power of Canadian agriculture, not in analytical probings of economic efficiency. Equity problems are interesting to analyze, yet solutions to these will be found through channels of advocacy rather than objective economic analysis.

Another question relates to the structure of the Canadian food system once the production level is presumably well regulated. Lack of evidence for stability leads one to question again the myth that farm level efficiencies are passed on willy-nilly to consumers. Stickiness of margins, paths of price decline different from those of price increases based on demand and income elasticities, and the role of labor unions could well explain most of the reasons why the authors of this paper felt frustrated at not being able to produce more viable evidence.

Finally, a more intelligent use of forward contracting could lend a stabilizing force to the goal of market stabilization. A question is: Could the regional boards work in concert

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with a national board to moderate "local" supply pressures in view of a larger whole?

Marketing boards might have outlived their usefulness to allocate farm resources efficiently because they effectively limit competition and they may ignore the macro effects of their actions on consumer price indices. Yet, as indicated, they also may serve other more positive roles in rural areas and in the halls of regional and national governments, roles different than those first set for them, roles which have evolved and which now need probing policy exploration.

In sum, this well done paper opens a door on marketing policy analysis for which the authors should be congratulated even if they do not choose to be iconoclasts.

The Rausser-Stonehouse paper explores the impact of government intervention in the Canadian dairy industry on producer's supply response. It is a well conceived paper, well researched, and inventive in its use of empirical methods.

This paper is notable for its recognition of how policy is made, how it works, and how these aspects might be integrated into some type of useful policy analysis along with relevant private sector considerations. While the focus is producer supply response for dairy, this is somewhat misleading because private sector response could be interpreted as only mechanical adaptation to mandated incentives determined by the political process, a process which they acknowledge, but do not analyze fully because the paper presents preliminary results only.

The authors state that government officials determine domestic and foreign trade goals and then work backwards to producers through processors. Their description of this mechanism is delightful and laugh-provoking to an ex-bureaucrat once responsible for setting state milk prices and quota limits. The potential frustrations they point to are accurate. No politically determined price-setting mechanism can endure forever in the face of alleged inequities by producers, processors, retailers, and consumers.

In view of their excellent start, I was dismayed in their literature review that no mention was made of interviews either with agency administrators, producers, or consumer advocates since these perspectives were ones the authors attempted to specify as structural parameters requiring behavioral equations. In addition to using "unconventional" empirical methods, perhaps it is also time to introduce more listening to participatory or affected groups and individuals. No matter how good the method, if it is not aimed at the proper variables, the ensuing analysis is useless for policy makers. For example, references might be made as to how politicians and administrators pursue risk-reducing paths; producers are not the only ones whose livelihoods are at stake through miscalculation about risk.

In milk, the prime movers seem to be the policy makers, followed by administrative implementors. Interpretations made by the administrators are, in turn, adjusted to by those persons involved at the producer-processor level, depending on the particular program. Aggregated response from atomistic production units usually can be based on profit motives; farmers are businessmen, too. Yet this response is largely conditioned by government (agency) policy as the authors note when a commodity program exists.

Another policy aspect is that while producer's milk response, for example, may be thought by some to be a function influenced by government "demand" (or market of last resort), it is also highly influenced by cost-increasing regulations which also can weigh heavily on the supply side. How to integrate these aspects is, indeed, a major problem; yet, without some attention paid to them, analysis of production response could miss the point.

An item I found confusing (by its absence) was lack of reference to consumer attitudes toward milk prices and their role in their food budget. Admitting that rationality is a highly adaptable word and that effective advocacy is the power behind most policy changes, the effects of milk prices on inflation certainly ought to be covered in any discussion of milk price policy.

In summary, this paper provides a useful breakthrough in identifying policy parameters, in combining private and public sector behavioral equations, and in daring to suggest the use of qualitative measures. Table 1 shows the authors' logic in a qualitative sense; table 2 shows their preliminary empirical results. The authors should be applauded for these innovations. I hope in the near future that their work can also incorporate discussions with appropriate policy administrators, legislators, and producers; that it can also consider the consumer side of the coin as well as the producer-processor's; and that they make more use of the "normative" models they mention to construct, perhaps, an ideal which allows adequate milk production at reasonable prices and which also lends itself to easily enforceable administration.

Effects of Marketing Boards on the Agribusiness Sector

Thomas F. Funk and Martin T. Rice

The titles of the two previous papers are indicative of the current and past emphasis of research and discussion concerning marketing boards. Although these institutions have effects outside the producer and consumer sectors, these effects have not been the direct subject of research by agricultural economists. This is unfortunate, because as Loyns and Loucks have pointed out, marketing boards should be studied in relationship to the "entire competitive framework and overall marketing efficiency if we are to take a broad view of food policy issues."

We have been asked to look at the question of the effects of marketing boards on the agribusiness sector. Undoubtedly these effects vary depending upon the type of industry and marketing board involved; however, because of the lack of research evidence covering a variety of situations, our comments will pertain mainly to the Ontario Broiler Industry and its supply management marketing board, the Ontario Chicken Producers' Marketing Board (OCPMB). This industry was the subject of a recent study to determine the nature and extent of possible effects of a marketing board on agribusiness, and therefore should serve as a useful case study from which tentative inferences can be made to other situations. The study was conducted in early 1978 and consisted of in-depth personal interviews with general managers from all the major sectors of the Ontario Broiler Industry. Rice provides a detailed discussion of the methodology and results of this research.

To approach the question we would like to make a few general observations on what we believe to be the major effects of marketing boards on agribusiness. Although the term agribusiness can be defined very broadly, we will use it here to include only those firms having direct contact with the production sector. In the case of the broiler industry, this includes hatcheries and feed companies on the input side, and chicken processors on the output side.

The most obvious effect of a supply management marketing board on agribusiness is the transfer of market power from agribusiness sectors to the production sector. In the broiler industry this transfer of market power resulted in two fundamental changes: first, the supply of broiler chickens is no longer determined primarily by feed companies and processors through contracts and financing agreements, but rather through the quota allocation decisions of the marketing board; and second, prices of chickens are no longer determined primarily by market forces or negotiations between buyers and sellers, but rather through the pricing formula established by the board. These two basic changes in the environment in which agribusiness firms operate have had important effects on the broiler industry which we will discuss in the remainder of this paper.

Integration

The first effects are those dealing with industry structure. Beginning in the 1950s, there was a rapid movement on the part of hatcheries, feed companies, and processors to integrate their operations. Although much of this integration was with the production sector through direct ownership or contractual arrangements, a certain amount of it involved integration with other allied sectors.

Since the inception of the OCPMB in 1965, there has been a sharp curtailment of integration activities. This has been particularly pronounced in the case of integration to the production sector because of the marketing board's policy not to permit increases in quota ownership by an individual or organization

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beyond 75,000 square feet, or amalgamation of quota on one premise in excess of 35,000 square feet. Although there are certain loopholes which permit agribusiness firms to accumulate more quota, further integration to the farm level has been limited by the cost of obtaining additional quota and the fact that the maximum production capacity at any one location is too small to justify the purchase price of the premises and quota rights. The result of these factors has been to hold the ownership of production quota by agribusiness firms to approximately the same level which prevailed at the time the marketing board was introduced.

The fact that integration to the production sector has been slowed by the restrictions of the marketing board has resulted in a production sector characterized by a large number of relatively small producers. Although large, integrated firms report that this creates some inefficiencies in the form of higher selling and distribution costs, smaller independent firms attribute their very existence to this situation. They claim that in the absence of the marketing board they would have eventually lost their markets or sources of supply to the integrated concerns, and therefore been forced to leave the industry or sell out to another firm.

Integration of agribusiness firms with other sectors of the broiler industry also appears to be declining. Despite the fact that "package deals" are still viewed as desirable by many growers, the available evidence indicates that many firms are offering these more on the basis of working arrangements with other firms than through ownership of these firms. To some extent industry managers attribute this situation to the marketing board's restrictions on the accumulation of quota under one owner on one premise. Because they feel that the ownership of the farm level is necessary to take full advantage of vertical integration, and because this is not possible under the current situation, they have decided to limit their integration into other sectors as well. In addition, the reduced profitability of the processing sector in recent years has made potential investments in this sector by feed companies and hatcheries very unattractive.

Margins

In addition to influencing changes in the rate of vertical integration among firms in the broiler industry, the presence of a marketing board also has had an effect on gross margins. However, unlike the situation with respect to vertical integration, the effects on gross margins have not been felt equally by all sectors. Survey results showed that most hatcheries and feed companies reported increased gross margins after the introduction of the marketing board, whereas all processors reported decreased gross margins.

The increased gross margins reported by hatcheries and feed companies were attributed mainly to the improved financial situation of producers brought about by the policies of the marketing board. Because of this situation, many industry managers felt that prices for chicks and feeds have increased faster than they would have in the absence of a marketing board. In addition, the improved financial situation of the industry has also reduced the amount of bad debts experienced by these firms. This is a very significant change for firms who, prior to the marketing board, had experienced substantial losses on contracts and mortgages held with their customers.

The decrease in gross margins reported by processors also were attributed to certain policies of the marketing board, particularly those related to pricing. Given the pricing formula used by the board to establish live broiler prices, most processors reported gross margins are depressed because they (the processors) are positioned between a relatively inflexible, cost-of-production determined price for their inputs, and a downward, flexible, market-determined price for their processed products. In addition, they claimed that because of the board's restrictions on production through its quota allocation decisions, their fixed costs are spread over a much smaller volume of output resulting in significantly higher unit operation costs.

The situation with respect to gross margin changes has been met with a variety of responses. In the feed and hatchery sectors, the increased gross margins have been responsible for some improvements in product quality, services to customers, and profits. In the processing sector, on the other hand, the decreased gross margins have been absorbed by decreased profits with little or no reported changes in product quality or customer service.

Operating Policies

Another possible influence of a marketing board on agribusiness is in the area of internal policy formulation with respect to such factors as pricing, promotion, product development, market development, and inventories.

Most managers in the broiler industry feel that competition within their sector, rather than the marketing board has had the greatest effect upon their decisions in the areas of pricing, promotion, and product development. A possible exception is that some feed company executives feel that pricing is not as important as it was prior to the introduction of the marketing board when producers were under greater pressure to obtain the lowest possible price for their inputs. Moreover, despite the fact that the OCPMB is involved in some promotional activities for broilers, managers in all sectors reported that this had no effect on their promotional decisions.

The situation is somewhat different in the area of market development. Here most managers in all sectors felt strongly that the pricing policies of the OCPMB eliminated the possibility of developing new markets for Ontario broilers outside of the province. In responding to questions in this area, a surprisingly large number of managers cited what ostensibly is an industry credo; "The marketing board should be called a production board because they have nothing to do with marketing." They supported this statement by explaining that the board takes no responsibility for marketing live broilers after they have been picked up at the farm by the processors, despite the fact that the board sets production levels and live prices which have significant impacts on the availability and retail prices of the final product.

In the area of inventory policy no changes were reported by the feed and hatchery sectors. Processors, however, reported sizeable inventory increases since the introduction of the marketing board. These increases were attributed to the pricing policies of the board which resulted in what they termed "unrealistically high prices" and a lack of proper incentives for growers to produce the weight categories in greatest demand.

Technology and Capacity

Other examples of specific influences of a marketing board on agribusiness firms can be found in the areas of technology and capacity utilization. As expected, research findings substantiate important influence in these areas.

First, the presence of a marketing board was found to reduce the incentives to make investments adopting new technology. This was particularly true in the processing sector where managers cited the lack of market growth and inadequate margins as reasons for adopting new technology at a slower rate than they would have in the absence of these conditions.

Capacity utilization was also found to be affected adversely by the policies of the marketing board. With the exception of two processors who specialized in processing imported chickens, all firms in all sectors reported operating below desired capacity. For a large proportion of firms the difference between desired and actual capacity was significant as it exceeded 20%. As in previous cases, the problem of inadequate capacity utilization was found to be somewhat more serious for processors than for firms in the feed and hatchery sectors because of the recent influx of eviscerated imports and the specialized nature of most processing plants.

Risks

A major area of influence of a marketing board on related agribusiness firms is risks. Since the inception of the marketing board in 1965, the Ontario Broiler Industry has seen a transfer of risks from the feed, hatchery, and production sectors, to the processing sector. This transfer of risk to processors, however, has not been accompanied by any risk premium for this sector. As a matter of fact, available evidence seems to indicate that the opposite situation prevails.

According to current operating policies, broiler producers assume the least amount of risk of any participants in the system. Because most of them sign contracts with processors before undertaking production, they are assured of a market for their product; and because their product is priced on the basis of a cost-of-production formula, they are assured that the price they receive will normally cover their production costs plus an allowance for a certain return on investment. As a result, about the only economic risks they face are associated with the value of the quota they own.

Feed companies and hatcheries also have

less economic risk than before the marketing board came into existence. This is mainly because of the stabilizing influence of the board which has led to less bad debts and fewer contracts and mortgages held by these firms.

Processors, on the other hand, have assumed substantially more risks as a result of the marketing board. These firms are now in a position where they must contract for their supplies three to five months before production without knowing, first, the price the board will set in the week the birds will be delivered; second, the percentage of basic quota which will be in effect at that time, hence the exact number of birds they will be obligated to purchase; and third, the price of eviscerated imports and the demand for broilers at the time of processing. This situation, together with the chronic low profitability of this sector, clearly illustrates the fact that processors have assumed the major economic risks in the industry without any real possibility of receiving compensation for the assumption of these risks.

Other Marketing Board Powers

So far my comments have centered on the two fundamental powers of any supply management marketing board, the power to set prices and the power to determine and allocate production quotas. Many marketing boards, however, have additional powers which, if exercised, can have beneficial or detrimental impacts on agribusiness firms.

Figure 1 shows ten powers and four procedures of the OCPMB and an assessment of the

Board Powers	Standard Deviations Hatchery	Standard Deviations Feed	Standard Deviations Processor
1. To Direct Marketing	1.84	0.45	2.50
2. To Pool	1.42	0.58	1.22
3. To Set Quotas	2.41	0.84	1.49
4. Commodity to be Sold to or through Board	1.33	1.21	2.60
5. To Control Agreements and Terms of Sale	2.39	0.84	1.72
6. To Require Licences and Information	1.81	0.41	1.49
7. To Determine Prices	2.1	1.41	1.99
8. To Prohibit Marketing	1.76	1.13	2.29
9. To Purchase Quantities	1.4	1.21	1.80
10. To Appoint Agents	1.35	0.38	1.32
Board Procedures			
1. Quota Advisory Committee	2.22	0.58	2.37
2. Research	2.11	0.89	1.80
3. Promotion	2.06	1.0	1.17
4. Information Dissemination	2.33	0.84	1.19

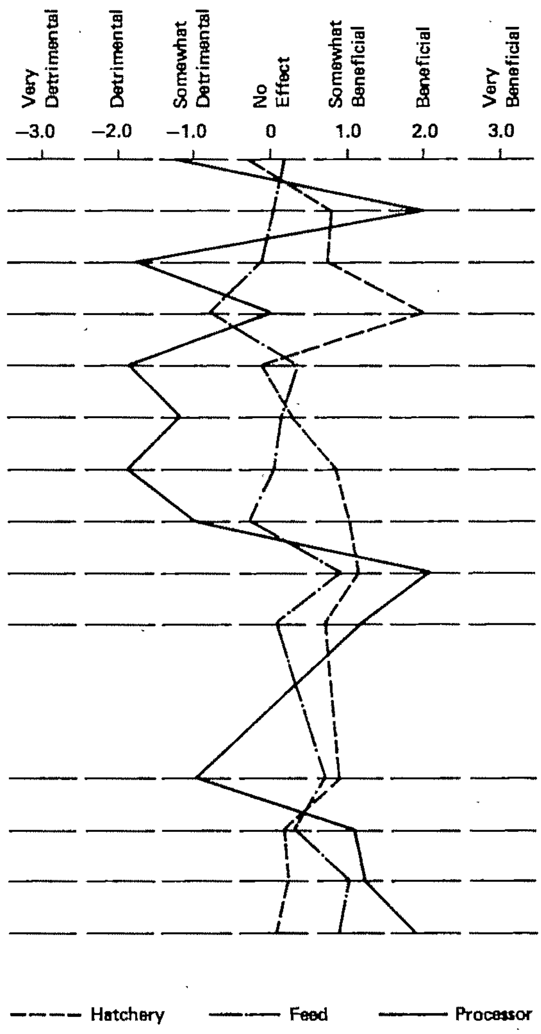

Figure 1. Aggregate impressions of the impacts of various board powers and procedures

impact of these powers and procedures on agribusiness firms. To obtain this information, managers from each sector of the broiler industry were asked to indicate the extent to which they felt each power or procedure influenced the operation of their firm. Their responses were placed on a scale which varied from very detrimental (−3) to very beneficial (+3). The midpoint of zero was assigned to the response of "no effect."

The first observation that can be made from figure 1 is that the assessment by industry managers of the effects of the board's powers to set prices and determine and allocate production quotas is about what one would have expected given earlier findings. Feed and hatchery managers perceive that while these powers have some detrimental and some beneficial aspects, in general they have very little overall effect on their firms. Processors, on the other hand, find these powers to have an overall "detrimental" effect.

Two other powers, the powers to pool and to purchase quantities of broilers are viewed as either "somewhat beneficial" or "beneficial" by many industry managers, particularly managers in the processing sector. The power to pool the proceeds from the sale of broilers in any week and then distribute these proceeds to producers on the basis of the amount of live chicken sold, was felt to be a means of allowing the marketing board to vary prices from day to day to meet competition from imported chicken without penalizing producers who happened to sell on days when prices were lower. This power is not currently used by the marketing board and, as a result, importers can wait until the weekly price is determined to make their pricing decision. Many managers felt that this was an important factor contributing to the present situation of a high level of imports from the United States into Ontario, and thus partially responsible for unused capacity and reduced profits in the Ontario industry.

The second power which is viewed as being beneficial by industry is the power to purchase quantities of chickens deemed advisable by the board. Although this power likewise has not been exercised, most industry managers feel that it should be used so management of the marketing board may obtain a more thorough understanding of the complexities of the market that can be used in improving their pricing and quota allocation decisions.

The third observation we would like to make concerning the information in figure 1 is the relative effects of the OCPMB on the three sectors we have been discussing. From this information, it is apparent that the board does not have the same impact on each of the three agribusiness sectors. In general, the board is perceived as being somewhat beneficial to the hatchery sector, somewhat detrimental to the processing sector, and having little or no effect on the feed sector.

Summary and Conclusions

In conclusion, we would like to summarize briefly the important influences of a marketing board on agribusiness. Because the following summary statements are derived from limited observations, they should be viewed as hypotheses for further research rather than as definite conclusions.

First, the extent to which a marketing board influences agribusiness depends upon the specific powers of the board and the extent to which these powers are exercised. Agribusiness views some powers as beneficial, some as detrimental, and many as having little or no effect.

Second, the extent to which a marketing board influences agribusiness also depends upon specific operating policies of the board. For example, boards that become more involved in marketing activities for the commodities they represent are likely to be viewed as having more favorable impacts than boards which are not involved in these activities.

Third, the powers of setting prices and determining and allocating production quotas, which are characteristic of supply management marketing boards, can influence related agribusiness firms in the important areas of industry structure, margins, capacity utilization, the adoption of new technology, and to some extent, the formulation of operating policies.

And, finally, the influence of a marketing board is not the same for all related agribusiness sectors. In general, the impact on firms in output sectors such as processing is more direct and detrimental than on firms in various input sectors.

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Effects of Marketing Boards on the Agribusiness Sector: Discussion

Bruce W. Marion

I am happy to see a paper with this topic included in a session examining the effects of marketing boards. Too often, we focus our attention only at the farm level; yet, the welfare impact of policy alternatives must also consider the impacts on the input supply and product-marketing industries and on consumers. A total systems perspective is called for.

In carrying out my assignment, I will give my assessment of the significance of the Funk-Rice paper and how it might have been improved. I will tackle the last topic first, since in the process the significance of the paper comes into clearer focus.

The paper is essentially a recitation of the highlights of a survey of agribusiness managers within the Ontario broiler subsector. It contains some interesting and useful material. However, it also has some important limitations.

The paper would have been strengthened considerably had the present contents been condensed to allow for a brief description of the Ontario and Canadian broiler subsectors at the outset and a discussion of implications at the end. For those unfamiliar with the organization of the Canadian broiler subsector, the alteration in property rights brought about by the Ontario Marketing Board is not clear. A brief discussion of the relationship of the Ontario broiler subsector to broiler production and marketing in other provinces and other countries—especially in the United States—also would have been helpful. The effect of a marketing board depends heavily upon the extent to which economic conditions and institutional arrangements allow goods to flow between areas.

The substance of the paper is that actions by the Ontario Chicken Producers' Marketing Board have stopped the growth in integration by agribusiness firms both into farming and into other parts of the subsector, have increased hatchery and feed company gross margins and reduced processor margins, have reduced the opportunities for the development of export markets, increased the inventories of processors, dampened the incentives for investment in new technology, lowered capacity utilization, and reduced the risk of growers, hatcheries, and feed companies at the expense of increased processor risk. In large part, these results are apparently associated with Board action to restrict broiler production and to increase farm broiler prices and broiler farm income.

Given this array of consequences, one must ask whether the survey results are accurate and reliable. Unfortunately, the authors say little about their research design or the reliability of their results. In my opinion, one of the major deficiencies of the paper is its empirical base, primarily "in-depth" interviews with the managers of eleven hatcheries, nine feed manufacturers, and fourteen broiler processors. Analyzing opinions and perceptions is far from a precise method of inquiry as election pollsters are quick to admit. Although these firms constitute the population in the Ontario broiler subsector, the extremely small numbers involved are grounds for concern.

The small and subjective data base and the virtual absence of hard data in the paper raises questions about the credibility of what is offered. Has the Board restricted production and elevated grower prices "unrealistically"? Are other provinces and imports taking away some of Ontario's markets? Have processors been seriously injured by the Board's intervention or has the Board simply eliminated excess profits? Data from either the firms interviewed or public sources would have been helpful in verifying or challenging the managers' opinions presented in the paper. In the process of reviewing the paper, I obtained data from Rice's thesis and from the Martin-Warley paper. A few of the more germane

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The views expressed here do not necessarily reflect the position of the U.S. Department of Agriculture.

points may be useful supplements to the findings in the Funk-Rice paper.

Between 1960 and 1971, all Canadian provinces instituted broiler marketing boards. Quebec was the last province to do so in 1971. Between 1965 and 1971, a period during which Ontario operated with and Quebec without a broiler marketing board, Ontario's share of Canadian broiler production declined whereas Quebec's share increased, surpassing Ontario in 1970 as the leading broiler producing province. Since 1971, Ontario and Quebec have both operated with marketing boards and with a market share agreement between them. The share of Canadian broilers produced in each of these provinces gradually declined to about 35% in 1976. Chick placements increased 3.2% per year in Canada during 1970–76; in Ontario the increase was only 1.5%. These data support the contention that the Ontario Board has restricted production.

A comparison of wholesale prices for eviscerated broilers in Ontario and the United States indicates a widening of the difference since 1970, and particularly since 1974 (Rice). Ontario prices were as much as 25¢ per pound higher than United States prices during 1974–76. Import barriers of 12¢ to 14¢ were easily overcome with this price difference. Imports surged northward. Although U.S. imports represented only 0.5% of the quantity of chickens slaughtered in Ontario in 1965 and 1970, they were 13% by 1976. These data support the assertions that the Board has unrealistically raised prices and seriously eroded opportunities for the development of export markets.

The foregoing facts plus other published information generally support the results of Funk and Rice's survey. Together with the lack of compelling evidence of improved stability from supply management marketing boards, Funk and Rice's findings represent a rather discouraging assessment of the effects of these boards. From a societal standpoint, the losses appear to exceed overwhelmingly the benefits.

Canada has been much more venturesome than the United States in trying alternative marketing and control arrangements. As long as provincial and national authorities also have the wisdom to abandon arrangements that do not work out, this innovative spirit is to be applauded. As a side benefit, Canadian innovations provide some extremely valuable opportunities for comparative analysis with the United States. Unfortunately, the bureaucratic process tends to be better at creating than at eliminating. If additional research supports the findings of the present papers, the future of broiler marketing boards will depend upon the willingness of those in authority to continue an institution that seems to benefit farm net income but penalizes processors and consumers, and that negatively influences Canadian exports and employment.

Identifying the trade-offs involved is an important research mission. Although there are some important deficiencies in Funk and Rice's paper, I applaud the type of research presented at this session. More research is needed which evaluates the impact of market rules and institutions.

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The Development of the Economics of Information: Implications for Extension and Research
(Lynn W. Robbins, University of Kentucky, Chairperson)

Developments in the Economic Theory of Information

Ludwig M. Eisgruber

Neither theory nor methodology exist to address adequately the economics of information, and, until recently, little effort was made to overcome this deficiency. A number of factors contribute to this deficiency: (*a*) for most information systems, particularly the public information systems, there is no market price that would suggest the value of information and information systems; (*b*) information is not a physical good and, therefore, lacks the concreteness that provides a basis for valuing many items such as, for example, a reclamation project; (*c*) most information systems do not have an impact that is observable in easily measurable variables. Therefore, currently existing econometric techniques are of little assistance in estimating information values; (*d*) public and private values of information may differ significantly.

Interest in this topic has grown substantially in the past decade, particularly as far as agriculture is concerned. Task forces within USDA, papers at the American Agricultural Economics Association, hearings at OMBA, FAO meetings, Bureau of Census deliberations, NASA-commissioned studies, all attest to heightened interest in the area of economics of information. Several developments contribute to this upsurge in interest: (*a*) costs of information and information systems have risen rapidly; (*b*) income distributional impacts of differently structured information systems are recognized; (*c*) there is increasing understanding that our ability to conceptualize is limited by data; and (*d*) related to the above, the growing awareness that during the past decade our profession may have relied too heavily on deductive analysis without proper concern for the relevance of the data base. The result is that an increasing amount of work was completed with increasingly irrelevant data.

The aforementioned developments quickly lead to recognition that economists have, to date, not developed a solid base of concepts and theories useful for the analysis of economics of information.

Some Basic Concepts

Data are not information. The demand for data is generated by the need to make decisions on problems, but decision makers rarely use raw data. Rather, there are intervening acts of interpretation, through statistical and economic analysis, policy staff and political evaluation, etc., which transform data into information by placing them in a specific problem context to give meaning to a particular decision. Consequently, an information system includes at least the following: (*a*) data system (collection, storing, processing, retrieval); and (*b*) analytical capabilities to interpret the data (theory, methods). This implies that unless economic theory and economic statistics meet on common conceptual ground, there can be no mesh between empirical analysis and theory, that is, between the inductive and the deductive process of "knowing" (Bonnen).

Several significant conclusions follow. For one, development of an economic data base cannot be left to "others." It is here that agricultural economists in the past decade may have failed in a fundamental way. This happened when the philosophy developed that, at the very minimum, data collection should be

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left to others, and perhaps, more likely, that those economists involved in data collection and data system design were of inferior quality. Second, since institutions and circumstances have changed, should not theories and data bases also have changed? Third, to what extent have the aforementioned emerging needs and general concepts been captured in the development of a theory or theories of information? The following comments are designed to provide an overview of developments and current status.

Related Areas

Those who have followed research in at least two other areas will recognize similarities between general approaches used in those areas and the general approaches discussed below on the economics of information. These two other areas are those of (*a*) benefits of research and (*b*) technology assessment. This should not be surprising, as the research process produces information.

Agreement, Controversy

No integrated operational theory or methodology exists for placing value on information or for selecting the most appropriate information system. In this respect, it should be pointed out that the government policy-making process and the increased emphasis on rigorous program evaluation contributes to what has been called the "mythology of methodology." While present policy and philosophy may call for a rigorous evaluation of all programs, it must be recognized that this requirement calls for something which exceeds our current ability to conceptualize, and certainly to analyze empirically. Many questions concerning the value of information fall into this category.

A General Model

Economics of information deals with the question of selecting that information system from among many which will provide the largest benefit over time. A general model of the economics of information can be gleaned from a number of writings (Eisgruber, Marschak, Menges, Miller), and formulation of such a model of economics of information can appear to be deceptively simple. To demonstrate its underlying complexity, let us examine a general model suggested by Marschak:

$$(1) \qquad \text{Max: } D = E(g) - E(k),$$

where $E(g)$ is expected gross payoff, and $E(k)$ is expected cost, and further,

$$(2) \qquad E(g) = G(\lambda, \alpha; \Pi, \gamma),$$

and

$$(3) \qquad E(k) = K(\lambda, \alpha; \Pi, \chi_\lambda, \chi_\alpha),$$

where λ is the process of inquiring (collecting information, experimenting); α is the process of deciding; Π, probability that certain events will occur once a decision is made; γ, benefit (payoff) function; χ_λ, cost of inquiring; and χ_α, cost of deciding. The semicolons in equations (2) and (3) separate the entities "controlled" by the manager from those "noncontrolled" by him.

This model is relatively simple, at least on the surface. But, let us examine the components further. For instance, which decision criterion should be applied in the maximization process: Bayes' criterion, Wald's minimax criterion? Should the objective be to maximize net social benefits regardless of distribution, or should income distribution (producers versus consumers, rich versus poor, producers versus processors, developed versus less-developed countries) be the overriding criterion, or which combination of the two? Another consideration is stability of economic and other processes as well as a host of qualitative aspects. Concerning λ, the process of inquiring, what amount of time and money should be spent on gathering information about the outcome function? How should one proceed if no preference ordering at all is given among the outcomes? How exact and how detailed should the information about the cost function be? How, if necessary, should this information be obtained? Is a sample to be drawn? Which variables are characteristic of the states of nature? In equations (2) and (3), Π, the probability that certain events will occur once a decision is made, depends both on the probability function associated with the outcome of a particular action given a certain state of nature as well as the probability functions associated with various states of nature. Thus, knowledge of these probability spaces is assumed. In reality, such knowledge is rarely available.

Thus, while the above all-encompassing

general model is attractive to the reflective, thinking mind, reality dictates a considerably less all-encompassing approach. Following this line of reasoning is likely to lead to the conclusions that, due to differing circumstances, different operational systems are appropriate, and that the pursuit of the one ultimate operational system is not as productive as the concentration on individual improvements. However, the comprehensive concept will aid in deciding which of the many possible individual theories and information systems resulting therefrom should receive the highest degree of attention.

Manageable Approaches: Some Schools of Thought

A review of work to date suggests three different approaches (schools of thought). These will be discussed in turn and are as follows: (*a*) decision theoretic approach, (*b*) net social benefit approach, and (*c*) scoring approach.

Decision Theoretic Approach

This approach readily reveals many of the components identified for the general model. The theoretical basis for this approach was developed by such pioneers as Marschak and utilized in empirical agricultural economic analysis by Baquet, Boehlje, among others. The approach rests on the assumption that several future states of nature are possible. It is not known for certain which of these states of nature will exist, but the likelihood (probability) of each situation is known. A variety of courses of action are presumed to be available to the decision maker and, depending on the course of action taken and the particular situation actually occurring, the results (payoff) will differ. Stated more concisely, the decision theoretic approach is basically as follows:

Action: A_i; $i = 1, \ldots, m$;
States of Nature: S_j; $j = 1, \ldots, n$;
Payoff: x_{ij};
Probability of S_j: p_j;
Expected Utility: $V(\cdot)$;
Then, with a given state of knowledge:

$$V(A_i) = \sum_j p_j \cdot V(x_{ij}) \quad \text{for} \quad i = 1, \ldots, m. \tag{4}$$

Suppose information becomes available. This will modify the p_j's according to the Bayes' Rule. Let the modified probabilities be identified by $p_{j|I}$. But there is a cost associated with obtaining this information. Let us designate this cost as $C(I)$. Now

$$V(A_{i|I}) = \sum_j p_{j|I} V \cdot (x_{ij}) - C(I)\,. \tag{5}$$

It is now possible to evaluate the value of alternative information systems. The decision theoretic approach provides a way for a systematic examination of these various strategies. It also permits the recomputation (or modification) of the likelihood of certain situations coming true as a result of an improved information system. The major problem with the approach is that estimation of the likelihood (probabilities) of the various events is a difficult and gigantic task. As a result, this approach so far has been used primarily for relatively simple micro or firm problems (e.g., value of frost forecasting information in preventing frost damage in orchards). However, a few examples of this approach to the solution of aggregate problems are becoming available (e.g., Bradford).

The Net Social Benefit Approach

Although the idea of measuring social benefits was proposed as early as 1844 by Dupuit, it was not until 1972 that this approach was used in an empirical analysis of an information system (Hayami and Peterson). In very simple terms, the argument is that lack of information (or wrong information) is equivalent to a shift in the perceived supply (or demand) functions and thus impact on net social benefits (*NSB*). Specifically, let *NSB* be defined as

$$NSB = SB - SC, \tag{6}$$

$$= \int_{q_0}^{q_1} f(q)dq - \int_{q_0}^{q_1} g(q)dq, \tag{7}$$

where *SB* is social benefits and *SC* is social costs. According to equation (7), the former is defined as the area under the demand function (between q_0 and q_1), and the latter as the area under supply function (between q_0 and q_1).

With perfect information, *NSB* will be maximized. Imperfect information on, say, available supplies will affect pricing and inventory operations, which later will have to be corrected as additional information about the true supplies becomes available. The result is reduced *NSB*. The value of an improved information system is $NSB_1 - NSB_2$, where NSB_1 and NSB_2 are, respectively, the values of *NSB* (in 6 and 7) evaluated in terms of the improved and the old information systems.

A variety of techniques exist for estimating the relevant relationships; they may be econometric or simulation techniques. Supply functions, for instance, may be estimated directly or built up from production functions. Changes in consumer/producer surplus can be separated. Under certain conditions, certain assumptions might be made about elasticities, avoiding the need to estimate them. Elasticities from other studies might be used.

In its simplest form, this approach makes the usual assumptions of perfect competition, perfect mobility, and statics. However, considerable progress has been made in methodology (Bradford, Heiss). Models (and associated empirical analyses) are available which permit the assessment of the value of information over several years and with monthly time intervals within years. Dynamic programming was used to solve the model. The same researchers also consider more than one market (i.e., domestic and international), and estimate the value of improved forecast information with Bayesian speculators.

Scoring Approach

Few people would classify the "scoring approach" as deserving of the title of an "economic theory of information." The approach nevertheless deserves mention if for no other reason than to point out that the complexity of the economics of information systems often defies analysis by available economic theory and methods. The scoring approach may then be used.

Scoring models are relatively simple procedures to formalize the choice of an information system. Key evaluators (users, scientists, policy makers) are called upon to express their evaluation of various information systems (or the systems' components). Several evaluation criteria can be considered, but they will have to be weighted as to their importance. Schemes for scoring are generally simple, but can be very structured. They may also be demanding with respect to data requirements. The simplicity of the scheme can mislead the evaluators into thinking that the problem is simple. Also, contrary to first impression, this approach is not inexpensive, as it requires much time input from very expensive and scarce talent.

The "Panel on Methodology for Statistical Priorities" of the National Research Council recently has recommended this approach for the evaluation of various statistical systems. The National Academy of Sciences Study Team on Information Systems for World Food and Nutrition has also used this approach in the development of its recommendations to the Academy's "World Food and Nutrition Study."

Concluding Comments

Those concerned with economics of information and with the design of information systems are faced with a dilemma of several dimensions. For one, while the design of a monistic system appears attractive, it becomes quickly evident that it is beyond practical capabilities. This leads to a number of separate, specialized systems. To the extent that these systems influence or represent social systems, such separate and specialized systems tend to fragment the social decision process with the danger, if not certainly, of externalities.

Economists concerned with the economics of information will need to be concerned with institutional changes. This concern is necessary because problems addressed by society change over time, thus requiring changes in information systems. However, institutions tend to institutionalize information systems, and therefore, make them progressively less effective.

The distributional impact of information of all types needs analysis. Such distributional impacts have two directions. For one, there is the question of the responsibility of the public to provide information so as to counteract the income distributional impact of private information systems. The provision of crop estimates, which are accessible and equally available to all, is one of these examples. The second direction deals with the income distributional impact of public information. Purported bias towards large farms of public information emanating from the Agricultural Experiment Station is an example of this dimension.

Finally, all countries and the public as well as the private sectors spend considerable amounts of resources on the development and maintenance of information systems. Yet, as economists, we have, to date, provided little by way of assessing the effectiveness of these information systems.

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Developments in the Economic Theory of Information: Discussion

D. Lynn Forster

Eisgruber's challenge is to review developments in the economic theory of information although "neither theory nor methodology exist to address the area adequately." Therefore, my task is that of discussing a review of inadequate theories in some enlightening fashion. It certainly is a perplexing position.

In introducing the topic and outlining some of the basic concepts, Eisgruber exposes the reasons for the inadequacy of the economic theory of information. Briefly, information is a system, not a product, with no market price, no physical dimensions, and no easily observable impacts. Also, social benefits of information differ from private benefits, thus externalities exist. Regardless of these complexities, choices need to be made in selecting information systems. There is an increasing realization that the user of information (e.g., the researcher) can improve his product by selecting the proper information system. Also, there is awareness that some gain and others lose when the choice is made, thus there is need to view the distribution of benefits.

A general model of the economics of information is presented precisely but dismissed as being too all-encompassing. Three "manageable models" are presented. First, the decision theoretic approach allows the user to select a system from a finite set of systems by viewing a payoff matrix and associated probabilities. Second, the net social benefit approach views improved information as shifting supply and demand functions which allows measurement of changes in consumer and producer surpluses. Finally, the scoring approach allows a number of users to score alternative use-information systems in order to select the "best" system.

Eisgruber states that "few people would classify the scoring approach as deserving of the title of economic theory of information." However, it is the most legitimate analytical process at this time.

In closing, Eisgruber states that economists to date have provided little to assess the effectiveness of information systems. I disagree with this indictment. While lacking a precise formal model to use in selecting an information system, our discipline has made a contribution to assessing information systems. At least six concepts have been mentioned by Eisgruber and others to assist users in making a choice.

First, selecting an information system is a continuous process and not a one-time choice among a number of alternatives. Bonnen's paradigm of the information process enters here. Reality is infinite in its variation. Particular data represents reality after the data collector categorizes the infinite possible observations with the aid of concepts of the real world, defines variables to measure these concepts, and finally uses measurement techniques. At the same time, deductive models are being developed which interpret the infinite variation occurring in the real world. Information is produced only after these deductively developed models are joined with data to interpret and analyze reality. Change requires a continuous process in selecting the best information system. Reality changes, concepts to define reality change (e.g., environmental impacts are suddenly recognized as important), variables to measure these concepts change (e.g., pollutant measures are refined with time), and measurement techniques change (e.g., new technology is introduced to measure more precisely a particular pollutant). Meantime, new deductive concepts change our analytical processes. Continuous changes in reality, concepts to define reality, variables to measure these concepts, measurement techniques, and analytical techniques require continuous information process selection.

Second, information has decreasing marginal

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returns and increasing marginal costs. Beyond some degree of accuracy, social benefits are not improved with improved information. Not only is this general concept helpful in selecting an information system, but in some cases methodology exists to quantify these returns and costs. For example, Freebairn's analysis indicates that vast improvements in current price information systems may produce only slight societal benefits.

Third, a number of information systems might be adopted within the same organization. Crucial determinants in selecting these information systems are variance in the value of the item being measured (risk), cost of the search, and the relative importance of the item (Kenkel). Information systems are necessary only when risk is present. As risk increases, the value of the information system increases. Thus, the desired information system is quite different for the low risk, relatively unimportant item with high search costs than for the high risk, relatively important item with low search costs.

Fourth, distribution of income can change drastically as the information system is modified. The most important issue in selecting information systems may be who gains and who loses rather than increases in societal welfare (Bradford and Kelejian).

Fifth, the property rights to information remain an unsettled issue. As information is produced with increasingly narrow scope, more centralized control is needed to integrate this knowledge. More centralized control to integrate knowledge reduces the number of sources of information. These few sources have a vested interest in keeping "trade secrets." On the one hand, these few sources may need to hold the property rights to information if disclosure would impair incentives to engage in socially productive research (e.g., patents). On the other hand, the public has the right to know in order to lessen uncertainty in decision making (Posner).

Finally, information needs are heterogeneous among clientele. This difference in needs may call for several systems in order to respond to clientele needs. For example, the system used by the land grant universities to supply information to part-time farmers may be substantially different than that used with full-time commercial farmers (Cummings).

In short, we lack an integrated economic theory of information as Eisgruber suggests. However, a number of economic concepts are available to help select information systems.

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The Developing Technology of Computerized Information Systems

Stephen B. Harsh

Space constraints allow only a narrow exploration of the subject assigned. Therefore, this paper discusses the potential impact of the developing technology on the design and usefulness of computerized information systems. This paper places major emphasis on examining the potential impact of technology already developed and tested. Less emphasis is given to theoretically possible or prototype technology because of the low probability that many of these technologies will ever become operational. In addition, this paper further limits the discussion to those technologies which are most likely to affect agricultural economists and their clientele groups. Finally, the technologies discussed in this paper reflect the author's interpretation of conversations with scientists in the computer and communications industry, reviewing the computer and information systems literature and the author's own experiences in this area. Emphasis placed on the various components discussed reflect the author's own perspective of the situation. It is highly probable that others acquainted with the topic would choose different, or emphasize other, concepts.

Components of an Information System

To analyze the impact of computer technologies on information systems, it is necessary to define the components of an information system. Davis makes a useful distinction between information and data which is illustrated graphically in figure 1.

Davis points out that there is usually an abundance of data. However, in many cases the data are insufficient for decision purposes. He defines data as groups of nonrandom symbols which represent quantities, actions, things, goals, and so forth. However, raw data contribute little to the decision-making process. On the other hand, when processed and transformed into useful information, data is conceived to be meaningful and useful for decision making. The processing is an important and necessary step in transforming data into useful and usable information. Other authors make similar distinctions between data and information and their role in an information system (Bonnen, McDonough, Eisgruber).

The Data System

The data base, an essential part of an information system, is experiencing numerous changes. First, there is concern that data sources are not as useful and complete as they once were. Bonnen stresses that many data sources used by agricultural economists were designed to address problems of the Great Depression and World War II. Since then, numerous institutional structural changes have taken place, and some of the data now being collected are either thin in numerical support or no longer appropriate. The problem is recognized by many and a specialized committee has been formed to address it. Bonnen further argues that some data bases are stronger than ever, especially since most of our data bases are now available on computer tape which lends itself to easy processing.

At the same time, there also has been a definite increase in new data bases and collection techniques available to agricultural economists. A significant reason for this increase has been the development and application of micro and mini computer technology. This technology has enhanced our ability for data collection on a real-time basis and greatly increased the number and use of data-processing centers.

One new technique being used for data generation is remote sensing. Experiences have

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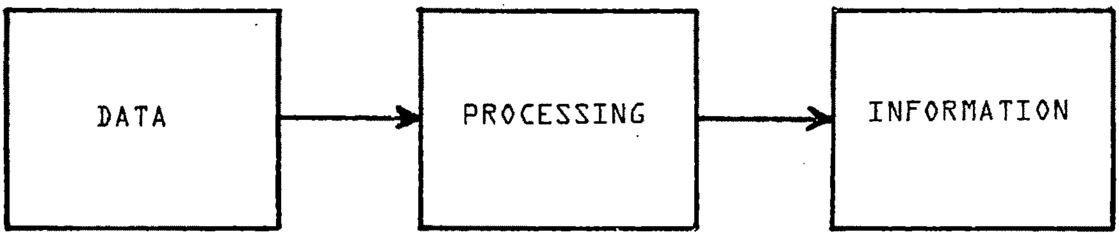

Figure 1. Components of an information system

been somewhat mixed as they relate to our ability to use the data generated for such purposes as compiling crop production figures and mapping topographical features (Manderscheid). Much of the data collected in this fashion is, or lends itself to, digital coding and, therefore, is easily processed by a computer system.

Micro-fiche is another format for data storage which is finding wide-scale adoption. It is a highly flexible, low-cost, very compact means of "publishing." Numerous documents, including many from the federal government, which in the past had either not been printed or printed in very limited numbers because of costs, are now being readily made available to libraries. However, most of the material on micro-fiche is, in reality, a photoreduction of the "standard" printed page. Finding data stored in this format is no less difficult than locating the same data in other library materials. Since much of the current micro-fiche data are being generated directly from computer systems (e.g., a "word processor" associated with a "computer output micro-fiche" device) involving no typesetting, there is hope that computer software can be devised to review a document and thus generate key words or phrases from the content. Successful development of this software, though still highly speculative, would expand greatly our ability to use computers to tap data bases.

Similarly, many public institutions are now keeping data in greater detail. Many county governments, education systems, health agencies, and other local governmental agencies have their own data-processing equipment which gives them more detailed and accurate data bases.

In the private sector there is also a major growth in data collection. One example of highly sophisticated data collection relates to farms in the U.S. which use infrared photography, daily monitoring of irrigation water, and leaf analysis to monitor and control crop production. Several large feedlots and dairies likewise keep very detailed records on individual cattle. Some of these data are actually being collected on a real-time basis with a mini-computer (Lamb, Pearson). Similarly, many major agricultural firms (e.g., grain companies) have developed their own data bases for making supply and demand estimates. However, much of these privately generated data are not readily available to those outside the firm collecting the data and, therefore, usefulness of such data is limited. Indeed, there is concern that the growth in the collection of data by the private sector will actually eliminate some of our existing data bases (e.g., on-farm computer processing of farm accounts will replace university-sponsored accounting projects).

Finally, if data sources are to be fully exploited, we must develop strategies for identifying and collecting useful data and train new professionals to cultivate and monitor our data bases. We must avoid the duplication of data bases and move towards a greater sharing of data bases. Bonnen has indicated the need to encourage people to consider data acquisition as a worthy professional career and to reward the innovative in this area.

Processing Data into Information

The next component of an information system is the processing of data into useful information. In addressing this component, the discussion is broken into two subparts. The first pertains to recent technological developments and refinements in computer software; the second section examines technological aspects of hardware.

Advancements in Computer Software

Recent advancements in software for computerized information systems have been fairly significant. An example is the development and refinement of information retrieval languages. The one that relates to our own profession, AGRICOLA, is an operational example of a highly sophisticated software language which can retrieve reference information, given key words and other search parameters. Other information retrieval languages include ERIC for education, and INFORM for business law, management, and finance. Their careful use should enable one to find most of the references that relate to a given problem.

In addition to the discipline-oriented information retrieval languages, there also exist generalized information retrieval languages. These allow the user a great deal of flexibility in establishing searchable parameters and encoding data into the retrieval system. In addition, some—such as Northwestern University's RIQS System—can do statistical analysis of the data and graphic plots as part of the information retrieval process.

Some advances in computer languages make it easier to process data. Data Resources has a highly sophisticated "economic programming language" which allows for building and estimating coefficients of large econometric models using a simple but highly specialized language. The language is backed by extensive data bases obtained from numerous government agencies and the private sector.

Computer manufacturers continue to release new, very sophisticated languages. An example is data-base management languages. These languages allow easy manipulation and retrieval data from large data bases for use by other computer programs. Similarly, new simulation, statistical, and other high level languages have been developed and refinements made in our commonly used languages such as FORTRAN, APL, and BASIC.

In recent years many specialized computer models have been developed to address particular types of problems, including those related to managing a farm or agribusiness, consumer issues, family financial management, community resource management, natural resource management, energy, and so forth (Lanpher). Many of these models are available on nationwide computer networks and are being jointly developed by several universities (Harsh). No doubt additional models of this type will appear in the future.

Despite significant advances, much more remains to be done in software. Contrary to claims in the popular press, we are a long way from developing a "plain English" computer language to use for information retrieval and other purposes. Unless a breakthrough of this nature is forthcoming, the software costs of information retrieval will become relatively more and more expensive in relation to hardware costs.

Hardware Advancements

Technological advancements in hardware have been more monumental. Computer systems are now faster, more reliable, easier to access, more powerful, and less expensive. This has been achieved through the use of faster processors, larger memories, new operating systems (e.g., virtual memory and time-sharing), and other cost-efficient technologies (Bowers). Of these, easier system access is considered very desirable (LaDue). Given this preference for easy access, communication systems with remote terminals are being used to achieve this goal. In communication, several technological advances are on the horizon. Some, it appears, will not greatly enhance communication capacity. For example, the benefits of optical fiber signal transmission probably will be used to solve communication problems of urban areas. Those who work with rural clientele likely will continue to be plagued by the limited capabilities of voice-grade telephone lines. Our own experiences indicate that in many rural areas, a 300-baud transmission rate is as often the upper limit of reliable data transmission. Telephone companies that service rural areas see a gradual, but slow, upgrading of these lines.

One breakthrough in reducing the cost of data communication was accomplished when the Federal Communications Commission allowed specialized transmission of data between metropolitan areas by a microwave network. It has been suggested the approach be expanded to make use of high-orbiting satellites for microwave transmission (Pullen and Simco). With this approach, all transmission would, in essence, be like a "local" transmission. Another possibility is the expanded use of two-way cable television transmission. This has proven to be fairly successful in transmission of data and information (Baldwin).

Another promising communication development is computer communication networks. One company specializing in this approach is the TELENET Corporation. It has numerous computer ports in major metropolitan areas and a nationwide In-WATS telephone system. With proper clearance, the ports and In-WATS system allows the user to access any one of several hundred computers attached to the system. In some cases, one computer actually can generate a call to another computer. As this capacity is developed and refined, our profession will benefit because it will be simpler to draw upon data bases and software located on the other computer installations rather than trying to duplicate them on our own computer installation.

Technology in the terminal area continues to advance at a relatively fast pace. Terminals have trended towards becoming lighter, less costly, more reliable, and with higher transmission speeds and more features. There are no indications why this trend should not continue in the future. As an example, a small terminal device with a keyboard can be used in conjunction with a television set that sells for under $200. The U.S. Weather Service is considering using this terminal in a pilot project to transmit weather information related to agricultural production to farm operators (Green). Although the terminal is not very sophisticated and has limited transmission capabilities, it puts terminal acquisition within economic reach of a very large audience.

Other advancements include the adding of features and speed to computer terminals. Today, a number of high speed (1200-baud) terminals are appearing on the market. Other terminals are incorporating such features as internal memory (e.g., bubble memory) for temporary storage, editing, and retrieval of data. Still others allow the user to manipulate data before transmitting on a larger computer system. These added features and speed should enhance our ability to manipulate data in the processing phase.

The computer mainframes technology likewise continues to advance. As stated earlier, today's computers are more powerful and less costly than the computers of yesterday. This has been accomplished partly through the extensive use of large-scale integration (LSI) technology. Applied to our larger computer installations, such as those commonly found on university campuses, LSI will no doubt influence our ability to process data into information more efficiently.

However, the real potential breakthrough in applying LSI technology lies in the micro- and mini-computer area. With an investment—ranging from a few hundred to a few thousand dollars—it is possible to have on-site fairly extensive computer processing capacities (Didday). Many users now can have their own dedicated machine to tackle their unique problems. In addition, these computers can be used as intelligent terminals and interface with larger computer installations. With the low investment cost involved, it is highly conceivable that computer-processing power will be readily available to most small businesses, government agencies, educational institutions, and so forth. The FACTS program at Purdue University illustrates the use of these small computer systems. Each of the counties in Indiana will have a mini-computer for processing certain problems locally, with capabilities to interface with the larger host computer on campus. The chief limitation in the adoption of these computer systems appears to be related to the rate in which software can be developed to support these machines and how the data bases now associated with the larger mainframe computer systems can be segmented, formated, and stored on the smaller storage devices of micro- and mini-computers.

The Information System

The preceding discussion has stressed that information is processed data. At this point in discussing the components of computerized information systems, it is necessary to incorporate the human element. For processed data to become truly useful information, the persons involved in generating the information must understand the nature of the problem, the data bases appropriate to the problem, and the required processing needed to transform data into useful information. There is nothing on the horizon in computer technology that can replace this human skill. For a computerized information system to be successfully used, we need to stress the importance of this aspect of an information system. If we attempt to make our students more knowledgeable regarding data bases, computer technology, and quantitative techniques, the potential for advancement in this area is high.

Summary

This paper relates some of the technology that should enhance our ability to develop and make use of a more powerful computerized information system. The paper is concerned about the data bases upon which the information system is built, how the data are processed into useful information, and the role of the human being in using a computerized information system. For these technologies to be successfully utilized by our profession in developing better information systems, it will demand that innovative and resourceful people apply their talents to this exciting and challenging area.

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The Developing Technology of Computerized Information Systems: Discussion

Ron E. Shaffer

I have only minor differences with Harsh's paper. However, I have a greater concern about what the paper fails to say. A discussion of computer technology seems to miss the major concern about our present information systems. I believe we have reached a point that our information delivery mechanisms are mechanically better than the data being delivered. As Harsh's figure 1 so aptly points out, information is a result of data and processing. At present, the processing mechanism is not the scarce resource in information output.

The comment that "many of the county governments . . . now have their own data-processing equipment which gives them more detail and accurate data bases" is symptomatic of information system problems. The possession of a data-processing system does not insure "more . . . accurate data bases."

I sensed that the discussion of advancements in computer software subtly moved from bibliographic searches (AGRICOLA, INFORM) to statistical packages (RICQS). The major theme of the paper is statistical data retrieval and the bibliographic digression is clearly an unnecessary diversion.

The paper finally arrives at the critical information systems issues in the brief "The Information System" section. It is at this point that I wish to add to the paper.

I believe we are all in agreement that there is an information problem in rural areas. At a recent conference on taking computers to the community, Chapman, Infanger, Robbins, and Debertin stated:

> Most rural areas do not have ready access to existing data. Ready access would be an improvement, but data cannot stand alone. Interpretation and instruction in data use are also needed. Data, whether gathered from state and federal sources or locally generated, must be coupled with a strong educational program to insure effective use. Data from federal and state sources are often discredited because they are two or three steps removed from the community, are often outdated, and are cumbersome to use. (p. 4)

Given this situation, our continued focus on computer delivery mechanisms is, at best, a less than optimal allocation of resources. There appear to be four information system problems. First, do we know the current structural relationships so appropriate data is being collected? Second, is the quality and accuracy of data for rural areas adequate? Third, how do we reduce misinterpretation and potential misuse of data? Fourth, can appropriate data be delivered in a timely and usable fashion?

The profession is being made increasingly aware of the first problem. [AAEA, Bonnen, Bell, Moore, Vlasin.] The appointment of an Economic Statistics Committee suggests that while the problem remains, there is hope that it will be resolved.

In regard to the second problem, the commentary by Edwards, Fritsch, Nilsen, O'Leary, Coltrane, and Holling concerning the economic consensus and the imputation of values for missing firms and rural areas is alarming and largely ignored by most users. This also includes the editing of some federal data tapes. I remain pessimistic about a solution to this problem, given limited financial support.

Third, we have not been very good about educating citizens and politicians, or even ourselves, about the judicious use of the data that we collect. We experience the old GIGO (garbage in—garbage out) problem. I am quite concerned about the "stone tablets" illusion when data is presented on a computer printout. In situations like this, inadequate data can become misleading information if not handled properly.

Finally, a dimension of the timely and usable delivery of data not mentioned by Harsh is

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the data overload phenomena. There is a tendency to provide volumes and volumes of tables and numerous scenarios through the simple push of a button on a terminal rather than to interact with the decision maker about appropriate information for that specific situation. We generate volumes of data, often presented in an inappropriate fashion, that, rather than clarify the situation for the decision maker, essentially overload him or her with superfluous material.

In summary, some new computer technologies are making information systems accessible to a wider variety of users. However, some very basic problems still exist in the conceptual basis for the data collected, the accuracy of that data, the ability of that data to reflect reality, and its appropriate use.

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Interfacing Research and Extension in Information Delivery Systems

Craig L. Infanger, Lynn W. Robbins, and David L. Debertin

One of the more recent computer applications in agricultural economics is the information delivery system. These systems are more than just another new "computer program" or "computer model." They are specially designed for computerized information delivery and analysis.

The emergence of computerized information systems is having a profound impact on the conventional roles of extension and research economists. Traditional relationships between extension, research, and clientele groups are being altered. The way in which these relationships change is directly related to the type system developed and the implementation methodology utilized. In this regard, the profession is confronted by two important sets of issues: (*a*) the development and implementation of information systems, and (*b*) the interface between extension, research, and clientele groups.

Issues in Development

Recently, Chapman, Infanger, Robbins, and Debertin surveyed extension directors and found fourteen information systems in use or under development. The most well-known of these systems include the Computerized Management Network (CMN) from Virginia, Today's Electronic Planning (TELPLAN) from Michigan, and the Minnesota Analysis and Planning System (MAPS). Though many questions and issues surround the development of these and related systems, several issues are of fundamental importance: the choice of technology, the selection of software components, research support for extension, and assumptions about user needs.

Batch Versus Interactive Technology

Operational systems can be classified broadly into categories: (*a*) batch-oriented systems, and (*b*) interactive terminal-oriented systems. These categories differ not only in the kind of hardware and software that is needed, but also in the kind of human support that is required. Information and programs available in a batch-oriented system are most often available for access only by those who possess a degree of programming skill. While batch systems can be designed for direct user access by clientele, more often a person with specialized skills in operating the system will act as an interface between the computer and the user. This is the organization of systems such as MAPS, ISEIRD (Illinois), and WILLIS (Illinois) (Chapman et al.).

Interactive terminal systems are normally designed for direct access by the user clientele and may appear to involve less personnel support. However, the demands placed on the adequacy of the software contained in an interactive system are substantial. The software writer must anticipate all possible user responses and systematically lead the user out of situations where he reasonably cannot be expected to bail himself out. Well-designed interactive software generally does not require any programming or other computer skills on the part of the client. This approach has been used by DISK (Kentucky), TELPLAN, CMN, and FACTS (Indiana) (Chapman et al.). An interactive system may require more total personnel support than a batch-oriented system but allows the computer to be taken to the user, rather than the user to the computer.

Selection of Data and Programs

Fundamental concerns and questions about the quality of data, analysis, and information have recently been articulated (Bonnen). Developers of computerized information systems

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have yet to address seriously the qualitative aspects primarily because quantitative problems are so imminent. While on-line disk storage space is rapidly becoming less expensive, educators and researchers cannot afford the luxury of storing data and programs that are not heavily utilized. Sporadically used information and programs can be placed in a less expensive form of storage, such as off-line disk. Extension clientele still may have access, but the time required for clientele access may increase from a few seconds to an hour. For example, the data selection approach used at Kentucky in the DISK system was to survey clientele with regard to specific needs; develop a cafeteria offering; monitor clientele use and add new components to the on-line portion of the system; and move sporadically requested data and programs to off-line storage.

Research Support for Extension

Much computer software is developed in conjunction with research activity. Even though the problem that the software solves may be relevant to an extension audience, the software may be ill-suited to these needs because input and output may be difficult for a lay person to understand. Candler, Boehlje, and Saatoff argue that the extension's software needs are more demanding than the corresponding research needs and that this explains the comparatively slow adoption of computer technology in extension.

While a research model may be used as the basis for an extension model, the amount of additional programming support and faculty time is substantial. Problems with models that would be of little concern to a researcher suddenly assume great importance to a farmer's individual farming operation. Moreover, no software can be built sufficiently foolproof so that it operates appropriately 100% of the time in an educational setting. The more complex the model, the more difficult the problem of testing the software using all possible combinations of client inputs.

Assumptions About User Needs

Developers of information systems often assume it is possible to store and retrieve data and programs relevant to clientele ranging from university researchers, to "cost-is-no-object" corporations, to rural governments, to individual farmers. Where researchers tend to generalize relationships among data, other clientele desire specific information and programs suitable for grant applications, community surveys, or farm plans. In many instances this information simply is not available. A small community may desire information on townships or census district level, a disaggregation too small for feasible system development. And even if it were possible to store information of this nature, there are those who argue that it is not of sufficient quality to be "locality relevant information" (Hobbs).

Batch-oriented systems which interface with clientele groups through a professional economist or sociologist are based on the assumption that time and money savings can be realized through prescreening data or program requests and professional assistance with completion of input forms (van Es). Thus, system personnel consult with clientele about the information or analysis request before the system is engaged.

Interactive remote systems assume that a well-designed, "foolproof" system will allow the user to access the system, define, and redefine information needs as the interaction between user and system progresses. However, the need remains for educational programs designed to acquaint potential users with the system, the adequacy of the data, the limitations of problem-solving software, and the need for clientele feedback.

Issues in Implementation

Computerized information systems, whether batch- or terminal-oriented, represent new technology subject to an adoption cycle. Such new technology is normally suspect until it has been proven through usage. Extension specialists need not be alarmed, for if a computerized information system is desirable, it will eventually sell itself to clientele.

System's Scope

One of the most basic implementation issues is the scope of an information system. Should it have a local, area, state, or national orientation? Initially, computer hardware was the costliest element of any system and, as a result, a national orientation would provide the least costly access to the very costly components. As computer technology has advanced, the cost of computing time has decreased but telephone charges have been relatively stable. Regional, state, area, and perhaps even local systems are becoming more and more cost competitive as long distance telephone charges play a relatively larger role in a total systems cost. The broader based systems are likely to maintain their advantage for offering access to large information blocks (data and related software) relevant to the nation that only require a short connect time.

The logical extension of the cost argument does not preclude a national system. A centralized, all-inclusive national system is unlikely, however. A federated or decentralized all-inclusive national system, made up of compatible national, regional, and state elements linked together via leased lines and a periodic call-up system is more likely. Compatibility is the largest obstacle to overcome, especially if the compatibility desired would include the extreme of data from one element being directly utilized in software from another.

The federated system does not require or imply the need for each state's participation. Smaller states, either in terms of resources or need, could link into the federated system at its nearest element. States without their own system might contribute resources to a neighboring state and actually develop a small regional system. This is the approach followed by the AGNET system.

Pricing and Cost Considerations

Extension traditionally has provided programs to clientele without charge. Of course, extension programs have never been "free"—they have been funded at taxpayer expense. The key feature of a computerized information system is that it provides information specific to individual user needs. Relative to other kinds of extension programs, the cost of providing this kind of information is comparatively high. Questions may be raised regarding the appropriateness of funding such a computerized network at taxpayer expense.

States are gradually resolving some of the price problems. Most systems will probably be funding with a combination of direct user charges and tax dollars. User charges usually do not cover cost items such as extension specialist salaries. Wages for programmers and keypunch operators may be included as is the direct cost of computer time.

Issues in the Research-Extension Interface

The conventional wisdom of the extension-research interface is illustrated in figure 1. The ideal that knowledge gleaned from research is delivered by extension is unmet (Scroggs, p. 888). Regardless of the imperfections of the conventional wisdom, computerized information systems are profoundly affecting the relationships in the extension-research interface. As the system becomes a delivery vehicle for educational and technical assistance, the client becomes one step removed from the educators and researchers. This is true whether the information system is basically a research-oriented system adapted to extension use (fig. 2) or an extension-oriented system (fig. 3).

Interfacing Research and Extension

The question of whether or not an information system would improve the situation remains to be answered. The answer hinges on the implementation and administration of the system and whether the approaches selected will change the conventional system. Can an information delivery system access and therefore provide more of that potentially useful information, or will it only be a streamlined technique for delivering, in a more impersonal way, what is currently being offered?

Should such a system be implemented and administered totally by and for extension, the conventional interface is least affected. Extension personnel would be left with their conventional devices for extracting information from research efforts. Some "demand-pull" effect might occur if extension feels responsible for justifying the delivery system by supplementing historically offered information with more "sophisticated" software. This "extension-tool-only" approach may provide

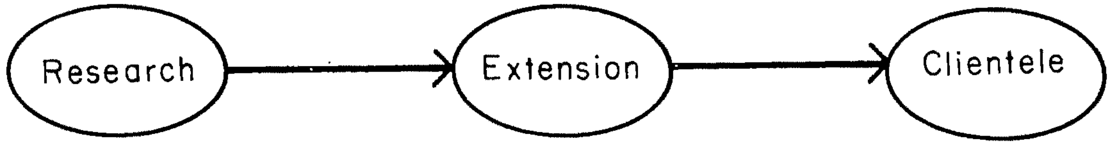

Figure 1. Traditional research/extension interface

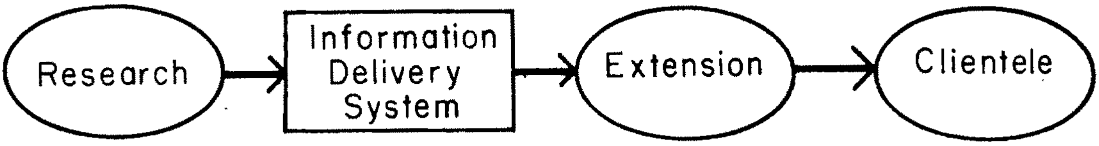

Figure 2. A research-oriented information delivery system

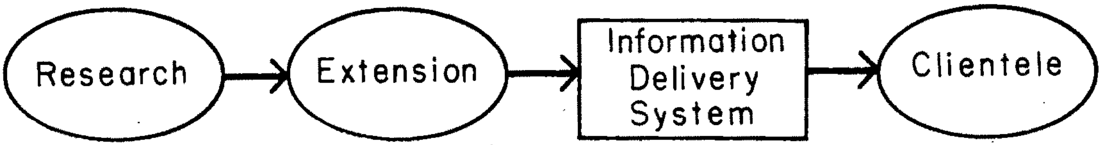

Figure 3. An extension-oriented information delivery system

sufficient justification for the technology even without the demand-pull effect.

To accept less than the full potential from a new technology seems inefficient. Data systems established for use by both extension and research would seem to be a solution (fig. 4). Both groups would provide inputs to the information delivery system and utilize its contents. The dual implementation approach does not, however, guarantee a two-party-oriented information delivery system where an interest or power imbalance exists. The extension orientation discussed previously could culminate from a dual implementation where research was disinterested or where extension exerts political power to protect "its" data system empire.

Complete success is unlikely whenever the contribution of two parties to an educational system is essential but only one party has initiative, motivation, and commitment. The system must be implemented and administered to motivate researchers to provide inputs to the system that can be utilized directly by extension and conversely (see fig. 5). A problem arises, for example, when researchers are rewarded for publishing research results but not for making a specific batch-oriented computer model into a generally applicable interactive program. Similarly, extension practitioners are not rewarded for completely specifying a data set but rather for providing that portion of the data required by their clientele.

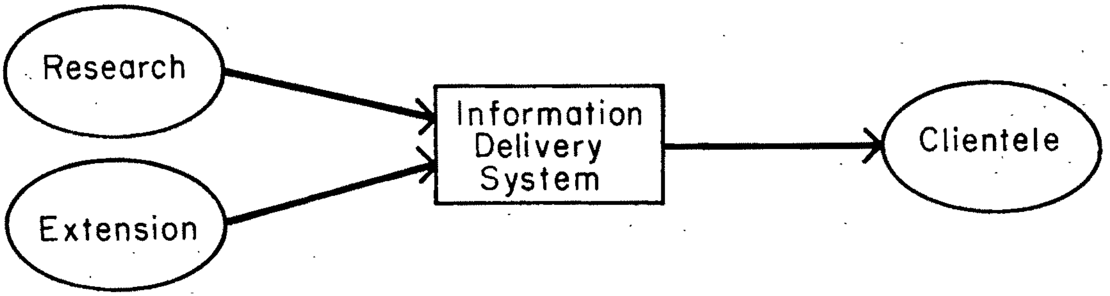

Figure 4. A dually oriented information delivery system

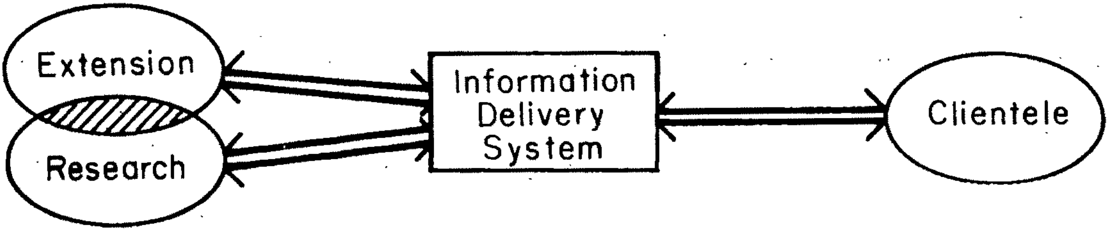

Figure 5. A mutually oriented information delivery system

Interfacing Extension and Clientele

The existence of an information delivery system will force some changes in the interface between extension and research, but it is also likely to have a two-way impact upon the interface between the extension-research team and their clientele groups. First, traditional clientele groups will be interacting with university educators in a nontraditional framework. Information will be more readily accessible at the grassroots. As a result, specific problem solution-generation will be redistributed away from the university and area levels toward the county and individual clients. Farmers and local bureaucrats will be able either to generate solutions to their own problems by utilizing regularly accessed data and software or receive solutions from their county agents who generate solutions from less well-known "system" techniques. Second, the university team will face many new nontraditional clientele groups who most accurately could be described as primary clients of the information system and only secondarily extension clients.

The impact on the traditional interface will depend upon the system's structure discussed previously. The batch approach will be the least disruptive to the client and the county level extension staff. Demand for service at the information center likely will require added permanent professional and paraprofessional information-processing specialists. An interactive structure requires the most adjustment at the county level. Even after county agents accept the system and are trained on it, the end-user clientele must be acclimated to the new technology. County offices will have to adjust their resources to process system requests. Both agents and end-users will have to learn to formulate their requests to fit the system's format.

Despite the structure selected for the delivery system, extension will be faced with serving a new nontraditional clientele group. Ethical and propriety questions arise at the new interface that have little, if any, historic precedent. Enterprises such as consulting firms conceivably could acquire delivery system output and resell it directly, or as a part of a larger effort, for a profit. A variable pricing approach may provide the necessary control once an acceptable user screening system is established. A pricing scheme that would vary from either zero or out-of-pocket cost coverage for traditional users to a going market rate for nontraditional clientele likely would provide the control desired.

Another important interface is between the information system and bureaucrats, both state and local. A successful information delivery system useful to policy makers would tend to increase the interdependency between extension and the bureaucracy and enhance bureaucratic support. Similarly, support for the educational effort should be enhanced at the area and state levels.

Lending institutions could tie loans to the utilization of the system's management-oriented software. Agribusiness supply firms might utilize the system to establish in their clients' minds the need for a product. The system would not promote a specific firm's products but it might provide a competitive edge. Here the caution is in the implementation. Ultimate clientele users and not intermediary organizations should shape the system's content. Objective market decisions and not product promotion is the obvious rule at this interface.

Conclusions

There is little question that agricultural economists will be more involved with information systems in the near future. For those who are engaged currently in development or implementation of a system there is an important need to: (*a*) coordinate the efforts among the states, the USDA Rural Development Service, and the USDA Extension Service; (*b*) more actively share experiences in regard to the basic questions of development, the field experiences, and perhaps most important, the impacts on the interface between extension, research, and clientele groups; and (*c*) assess the long-term viability of existing systems and the potential for a national information system.

For those seriously considering initiation of a system, some *caveat emptor* comments are in order: (*a*) an information system will have to force some changes in the interface between extension and researchers involved; (*b*) there is no general agreement on the relative advantages of a batch versus remote access organization; (*c*) costs are extremely high in terms of equipment and personnel and will preclude many of the smaller states from initiating their own systems; and (*d*) serious evaluations of existing systems have not been completed so there is little information to guide the "comparison shopper."

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Interfacing Research and Extension in Information Delivery Systems: Discussion

Harold W. Walker

The paper "Interfacing Research and Extension in Information Delivery Systems" presented some relevant issues and concerns. The authors did their homework and selected four main issues even though some are controversial. I am sure many research and extension faculty will disagree with one or more of the issues presented.

The Chapman, Infanger, Robbins, and Debertin survey was fairly comprehensive and proved quite informative. I recommend those interested in computerized information systems read the report as well as several other papers included in the Kentucky seminar proceedings referenced by the authors.

Computerized information systems are not quite as new as the authors imply. The topic was discussed at a Virginia Polytechnic Institute and State University seminar in 1971 (Walker) on work that had been underway for several years. The recent increase in interest is probably related to budgetary constraints in answering increasing numbers of inquiries for numerous clientele groups.

The appropriate level of technology still is being debated vigorously. Based on my experiences with CMN, CRIS, EMIS, and other computer systems, the noninteractive batch-oriented systems have a place. However, I think the future is with remote accessed interactive systems requiring no knowledge of computers and bypassing the need for a people-maintained interface. The more successful systems will be designed for direct user-terminal access with minimum interference by others. Our jobs will be in the area of education on how to use the information to make better decisions. As mentioned, such systems must be well designed and easy to use. Another alternative is to initiate the search interactively, search in batch mode, print the report on the high speed printer, and mail the information to the inquirer.

Designing a good user-oriented interactive system requires more effort than designing a batch system. The paper points out the pitfalls that must be avoided and the extra programming required to "idiot proof" the system. It can be quite frustrating to develop a good system, especially if you have experience in batch applications only. The adoption lag still exists in spite of our genius, so education in the use of the system is still needed.

I question the statement that interactive systems require more total personnel than batch systems. Maybe the interactive concept just forces us to do the total job as it should be done while we can stop short with a batch system and still struggle along. Also, batch systems forced many high-salaried faculty to learn computer-programming and job-control languages, while interactive systems can transfer these tasks to computer programmers.

The selection of data may be the most confusing issue raised in the paper. In fact, the difference between data and information causes confusion. Webster defines information as "an informing or being informed." This implies knowledge and the ideas inferred by the knowledge. Data is defined as "facts or figures from which conclusions can be inferred." Thus, data may be information to some but merely confusing gibberish to others. Data becomes information when it is converted into a form useful to the client. Consequently, our clientele should have a voice in formats used for delivering information because if they cannot understand the reports they are data but not information.

I dislike the "Research versus Extension" implication. Both groups are public employees and should be striving for the same goals, i.e., contributions to social advancements. I like the figure 5 concept but would overlap extension and research even more than shown.

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Neither group has a monopoly on knowledge or techniques. Research and extension must work together to progress. I urge you to read Candler's article referenced in the paper.

I am a little confused by the reference to "traditional" programs and clientele. The public is our employer and client so public needs should influence our programs. "Traditional" implies a static situation. We are charged with the task of improving social conditions through the development and dissemination of new knowledge—dynamic actions.

The authors consider the cost of computerized information systems high. Is that cost high compared with alternative methods of delivering information or is it high compared with not doing the job? Computer assistance is probably the cheapest resource at our disposal to get the job done.

Very good points were made on the scope of the system. Can we afford not to join hands in multistate efforts? With mini and macro computers becoming popular, the large university computing center is an endangered species. When large computers are removed from the university, what do you do with your in-state information system?

The fear that commercial firms may profit from our efforts does not bother me as much as it does the authors. Are we ready to move into direct competition with commercial firms? Do we want to become tax-supported commercial delivery services if existing commercial firms are willing to provide the service?

Last, the authors seemed to be concerned with "who gets the credit" routine. This is an old concern based on the weaknesses of faculty evaluations by administrators. Efforts should be directed toward correcting inequities in evaluation and rewards processes and not toward fighting between research and extension.

I compliment the authors on a good paper. The concerns expressed are real and must be resolved. Information systems for all audiences are in their infancies, and Kentucky will make a contribution with their work. There is much work remaining to be done. Research and extension efforts must be combined to do the job right.

I thank the authors for the privilege of discussing their paper.

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Consequences of Acreage Limitation and Other Provisions of Federal Reclamation Law (Peter M. Emerson, Congressional Budget Office, Washington, D.C., Chairperson)

Economies of Size and the 160-Acre Limitation: Fact and Fancy

William E. Martin

Two years ago, in August 1976, the U.S. District Court for the District of Columbia in the case of *National Land for People, Inc.* v. *Bureau of Reclamation et al.*, ordered the Department of the Interior to initiate rulemaking proceedings with respect to the criteria and procedures to be used in approving the sales of excess lands under the 1902 Reclamation Law. One year later, in August 1977, the U.S. Ninth Circuit Court of Appeals ruled that the 160-acre limitation of the Reclamation Act of 1902 applied to the irrigated farms of California's Imperial Valley—lands that were previously considered exempt. The Bureau of Reclamation immediately responded with proposed rules and regulations to enforce strictly the 1902 law on all Reclamation projects, including those projects served by the Corps of Engineers. The presumed economic and social consequences of putting the proposed rules into effect, after seventy-six years of benign neglect, are considered so large that a court-ordered environmental impact statement will be required before enforcement. Further, the original proposed rules are being revised and legislation to change the 1902 law is being proposed. Thus, it will be several years before strict enforcement could occur under whatever rules and regulations become final. It seems likely, however, that some permutation of the current proposed rules will be adopted (Bureau of Reclamation 1977). These rules form the basis for analysis in this paper.

The August 1977 proposal is basically as follows. Excess land is all irrigable land owned by an individual in excess of 160 acres that is capable of being served by the project. Owners of excess land must sign a "recordable contract" agreeing to sell excess lands according to terms and conditions satisfactory to the Secretary of the Interior, in order to receive project water. These terms and conditions are quite restrictive, as will become evident through the analysis of this paper.

The Proponents and Opponents

The major group on the proponent side is National Land for People, based in Fresno, California, near the largest reclamation project in question, the 527,000-acre Westlands Water District. Their rhetoric claims that "farming areas irrigated by U.S. Bureau of Reclamation projects in the 17 states west of the Mississippi River are farmed mainly by giant agribusiness operations with huge landholdings. . . . Federal taxpayers have plunged literally billions of dollars into federal irrigation projects—money which agribusiness giants are now reaping as subsidies. With enforcement of the 160-acre law, these federal subsidies would go to small farmers. . . . The average *irrigated* farm in California is less than 200 acres in size; and there are abundant examples of people making excellent livings on less than 160 acres" (Lewallen). There is a strong suggestion from the movement that the new farm owners will be former farm workers of Mexican heritage.

The opponents of strict enforcement are mostly farmers now receiving or expecting to receive Reclamation project water. The gen-

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eral argument is that farms larger than 160 acres are needed to exploit economies of size and to provide an adequate family income. Of course, their major worry is the rules on selling excess lands at government controlled pre-project prices. The rhetoric is "It's happening in America, in the United States of America. . . . Just a few weeks ago, the government told us they are going to take away our land. I know it sounds crazy—I still can't believe it myself." We are asked to call the Citizens for Government Fairness if the government has ever been unfair to us. I would like to know the response to that request.

The Projects, Owners, Crops, and Farm Sizes

The USDA report of February 1978 provides us with the following basic descriptive data. There are about 150 Bureau of Reclamation projects in seventeen western states. Approximately 9.3 million acres were actually irrigated, out of almost 11 million acres included in the project areas. About 2.3 million acres of irrigable land, held in 6,041 ownership units are classified as excess lands. However, all excess lands are not receiving water. Only 850,000 acres are receiving water for which they are not currently eligible. Another 259,000 acres are already under recordable contract. This acreage is receiving water and must be sold within the next ten years, but at least the sales are not coming as surprises to the owners. Another 57,000 acres are receiving water under statutes that will expire, leaving the land classified excess. Finally, owners of 132,000 acres have repaid the interest and principal on the federal loans and likely will be excluded from the new rules. Thus, the USDA concludes that perhaps 1.2 million acres of excess land will actually be sold (or transferred to a family member), about 22% of which is already under recordable contract. It is unclear, however, how the proposed residency requirement to live within fifty miles of the irrigated land mesh with these data. Should the residency requirement be enforced on current ownership, the amount of excess land to be sold could be greater.

Of the 1.2 million acres judged to be directly affected by the new rules, 265,000 are in the Imperial Valley—all recently judged ineligible but served with water. California projects served by the Corps of Engineers total 493,610 excess acres, only 158 of which are under recordable contract.[1] California's Westlands Water District contains 224,903 excess acres receiving water, but all but 1,146 acres are already under recordable contract. Thus, California contains 81% of the current excess acre problem.

Texas contains the next largest number of excess acres likely to be sold—only 22,637. Arizona is third with 16,645 acres. Nebraska, Montana, and Washington each contain between 11,600 to 15,400 acres. New Mexico, Oregon, Wyoming, and Idaho each have 6,000 to 8,700 acres. South Dakota, Oklahoma, and North Dakota each range from 1,200 to 2,800 acres. Colorado, Utah, and Kansas each have less than 1,000 acres. Nevada has paid off its 980 excess acres.

Any discussion of economies of size must relate to a particular type of farm. While 8% of Bureau land produced fruits and nuts (mostly in California, Arizona, and Washington) I assume we are not discussing fruit and nut farms. A 160-acre fruit orchard is a good-sized operation. A 320-acre orchard is a large size operation. It is unlikely that much excess land is in this category. Seeds and nursery products are only 2% of all Bureau lands. Again little excess land is likely from the seed and nursery industry. The largest categories of crop production are forage (37%), cereals (29%), and miscellaneous field crops including cotton, sugar beets, and dry beans (16%). Only 8% of the land is in vegetables, most of which is in California, Arizona, Washington, Idaho, and Oregon. Thus, we are basically discussing general crop farms with a crop mix such as cotton, small grains, sorghum, and alfalfa in Arizona (Kelso, Martin, Mack); or cotton, small grains, tomatoes, and alfalfa in the Westlands (USDA), or cotton, small grains, sorghum, cantaloupes, and alfalfa in the Imperial Valley (USDA).

In Montana (Luft and Guenthuer), the mix is small grains, irrigated pasture, and alfalfa. In New Mexico (Landrum et al.), the mix is likely to be cotton, small grains, and alfalfa. In the Columbia basin (Kezis), the mix is probably sugar beets, potatoes, beans, small grains, and alfalfa. In each area, grains and alfalfa will be well over 50% of the crop mix on a general crop farm.

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[1] It is possible that these acreages ultimately will be excluded from the rules. Imperial Valley farmers base their case on the fact that they had already privately developed the Valley with Colorado River water prior to construction of Reclamation's All American Canal. Of course, the Ninth Circuit Court disagreed.

Finally, we need some idea of the distribution of farm size in each area. While ownership is the basic criterion under Reclamation law, it is the size of the farming operation that is crucial to a discussion of economies of size. Further, the proposed rules allow one 160-acre lease per owner, thus the operating unit could be twice the ownership unit.

In the Westland Water District, there are a reported 1,822 ownership units with the average farm unit being seven times the size of the average ownership unit (USDA). Only 434 owners are reported to have excess lands, the irrigated portions of which are already under recordable contract. Southern Pacific Land Company is the largest owner with 107,000 acres, 80,000 of which are under recordable contract (USDA).

In the Imperial Irrigation District there are apparently about 950 owners with some 150 farming operations exceeding 1,000 acres in size, 241 operations exceeding 500 acres, and 380 operations larger than 180 acres. The surprising fact is that 335 units do have less than 180 acres (USDA).

Most areas outside of California apparently do not have the very large blocks of land in excess under a single owner. For example, in the North Platte Project in Nebraska, it is reported that more than half of the ownerships were in excess by 50 acres or less and only five owners were in excess by more than 250 acres (USDA). In the Columbia Basin Project in 1973, about 97% of the farms were 640 acres or less, although 3% of the irrigated land was in farms averaging more than 1,000 acres (USDA).

Economics of Size

It is impossible to avoid the conclusion that economies of size exist in farming, and that these economies, whether technical or pecuniary, have been a driving force toward larger and fewer farming units in the United States, especially in the irrigated West.[2] In question is what effects an arbitrary rule on maximum farm size would have on (*a*) current farm owners, operators, and farm families; (*b*) the opportunities created for new owners, operators, and families; and (*c*) the effects on the U.S. consumer in terms of quantities and prices of food and fiber. Issues such as the necessity for large farms in order for farming to exist are obviously red herrings. The land is there, it has water, and someone will farm it. The 160-acre limitation is clearly a question in the redistribution of income. We need to document possible benefits and costs to each group of winners and losers and then decide if the benefits to the winners are worth extracting the costs from the losers. Before attempting to do so, the economies of size literature must be reviewed.

Most formal economies-of-size studies have been carried out at Davis, although almost every state has produced representative farm budgets in which economies were implied. One of the earliest formal studies was that of Dean and Carter (1960) for cash crop farms in Yolo County, California. The typical crop mix was sugar beets, tomatoes, barley, and alfalfa. When "crops expanded in 'optimum' combinations, using minimum cost per unit of (total revenue) as the criterion of optimality . . . farms of about 600–800 acres appear to compete on a unit-cost and profit basis with much larger farms. . . . In fact, per unit costs tend to increase beyond this level" (pp. 54, 55). Farms with more than 200 acres were required to break even. Cost savings of about 20¢ per dollar of revenue accrued between break-even and minimum cost size.[3]

Johnston researched size economies in the Imperial Valley. Typical crop rotations were cotton, barley, sorghum, sugar beets, and alfalfa on the smaller farms, with a little less barley and alfalfa and the addition of some vegetables on the larger units. Minimum costs per dollar of total revenue began at 2,000 acres. Minimum costs were at about 80¢ per dollar; 160-acre farms could survive only by using all custom operations; costs decline rapidly to about 700 acres, then by only 5¢ or 6¢ to the minimum.

Other California studies, for farms near the Westlands District, were Faris and Armstrong and Moore. The basic crop mixes were similar as were the basic results. The technical economies were about exhausted at around 800–1,000 acres.

The minimum cost size apparently is somewhat smaller in some other irrigated areas. For example, Kezis has just reported that in the Columbia Basin Project nearly all economies have been obtained upon reaching 320 acres. However, another 4¢ drop is shown between 320 and 640 acres. Again, the basic crops were field crops, including a large amount of alfalfa.

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[2] Farms will tend to expand even in the absence of economies of size as long as diseconomies of size do not exist. More units of production are better than less even at the same net profit per unit.

[3] "Minimum cost size" is defined as the smallest farm size achieving minimum cost. Most studies show a horizontal long-run average cost curve for all farms larger than this minimum size.

Conclusions and Projections

Given the preceding rather lengthy, but still sketchy, background information, let us ask the following: Who is going to win and who is going to lose if the proposed rules are implemented in near their current form? The answers will depend on whether or not the rules achieve results within the spirit of a real land reform exercise. That is, will each rule really be effective, or will there be an economic way around it? Let us first assume reasonable effectiveness.

The Effects of Effectiveness

Holdings in excess of 960 to 1,280 acres, and especially large corporate holdings will be sold in parcels of 160 acres or less at lottery. The small farms created (about 4,200 according to Bureau of Reclamation, 1978) would each purchase its own machinery complement. The machinery complement assumption is crucial. Machinery is where the investment lies. Machinery is the basis of economies of size.

The large corporate farms obviously will lose. This loss is in the spirit of the law. In fact, the basic assumption of the law is that corporate farming is bad. Land will be sold at lower-than-market value at "pre-project" prices approved by the Department of Interior. Large machinery will be offered for sale in a depressed market where large machines are no longer desired. Of course, to the extent that the corporations are owned by many small stockholders, losses by "bad" corporations may be sustained by "good" people.

Given that there are economies of size, the marginal cost curves for the average farm, excluding the cost of land,[4] will shift to the left. Thus, assuming a constant total demand for food and fiber, total output of food and fiber will decline and prices will rise. One can project a production decline simply by noting that the set of production alternatives has been reduced by adding effective constraints. With higher prices, current farmers without excess lands will benefit. Since a family of six could own 960 acres, and conceivably rent 960 more, most farmers except corporate farmers will fall within this benefit category. The price rise will not seem large.

We do not have an estimate of how much production might fall. However, the price flexibility for food at the retail level is estimated at about −2.0 (Mann and George). Assume a 1% decline in quantity. On a 1978 base of $260 billion of personal expenditure for food (U.S. Department of Commerce), the loss in consumers' surplus would be slightly less than $5.2 billion, or a $24 loss per capita. A 1% quantity decline seems a very conservative estimate to me. Twenty four dollars per capita I feel to be significant.

The obvious beneficiaries of the enforced rules are the newly created farmers who will be buying the excess lands at "pre-project" land prices. For example, in the Westlands District, the currently approved price is $750 rather than $1,500 per acre (USDA). The blessing is mixed, however. As the Bureau of Reclamation states in its environmental assessment:

> The proposed rules state that an owner of excess land will divide it into parcels of no more than 160 acres. The rules indicate that a buyer will be selected impartially for each of these parcels. Following this procedure, a man and his wife would presumably have to submit their names for the sale of each parcel and then depend on the "luck of the draw" to acquire a contiguous 320-acre farm. The lottery could cause various economic impacts by selecting purchasers who lack sufficient assets, financing, and experience to farm successfully. Failure to organize the excess lands into economically viable units, to establish adequate criteria for eligible purchasers, and to provide adequate financing and managerial training, could result in severe hardship to the new family farmers. (p. 9)

Of course, nothing in the rules says an already established farm family cannot enter the lottery; say a family of five who currently are farming only 640 acres.

It seems clear that any restriction must tend to lower all land values and thus lower the ability of owners to borrow and invest. Of greater interest is how the rules apply to the sale of land for urban development. There is an enigmatic note on one of the Bureau's records of excess land in the Salt River Project for 1976. "Based on the conversion rate and pattern of the Project, we believe that these accounts will become municipal and industrial lands within the next few years. Therefore, any action regarding acreage limitations is largely meaningless." It would not be meaningless to an urban developer who could buy land at pre-project prices. If the rules apply, sales of excess land will cause urban sprawl and a land black market. On the positive side, urban developers would have to develop the property fully before resale, since land prices would be supervised. The proposed rules are silent on the urban land issue.

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[4] The irrigated land is a fixed resource which will be used. Its price may fall.

The Effects of Ineffectiveness

In my view, a more likely sequence of events is as follows. As with the "effective" land reform, very large holdings, including corporate holdings will be sold at lottery. However, here the story changes. Because there are significant economies of size associated with machinery ownership, the small farms created will not each purchase its own machinery complement. The large farms will reorganize their operations to include custom services at all levels of production. Rather than sell their machinery at a loss, they will use it for gain. One can imagine an acreage of 16,000 acres, formerly owned and operated by a corporation of 100 stockholders, now owned by 100 resident families who have as little to do with the daily operation of the farm as did the stockholders. The small farms would not be leased—that is against the rules. The lands would simply be operated under contract with the owners, the corporation providing inputs, machine services, managerial ability, and a market. "Intermediate technology" will have been avoided. There will be a smaller drop in the total quantity of production—maybe none—and consumer prices will be largely unaffected. The spirit of land reform will not occur, although the land value subsidy will be transferred to a few thousand other owner-nonoperators.

Final Fancy

Implementation should have some very interesting effects on the Bureau of Reclamation itself. While irrigation project construction is coming under increased criticism from the executive branch of the federal government, the proposed rules could stop construction altogether. For example, our work in Pinal County, Arizona, presumably to be a major recipient of Central Arizona Project water when it is delivered in 1986, shows 190 out of 400 farm operating units above 520 acres in size (Kelso, Martin, Mack). These lands are currently irrigated with groundwater and the new surface water cannot, by law, be used to expand acreage. Even though the new water will be subsidized to agriculture, in most areas the proposed price of water will not be less expensive than groundwater, even in 1986 (Boster and Martin). It would be folly for the farmers of Pinal County to accept Bureau water under the proposed rules for residency and excess land sales.

An alternative user of irrigation water in Pinal County, and elsewhere in the West, are the Indian reservations. The reservations are currently undeveloped or underdeveloped, and currently are seeking to define their water rights in the courts under the Winter's Doctrine. Much land is available for expansion of irrigated acreage. I see the Bureau becoming the Indians' accomplice rather than the white mans' as it has been in the past. Or will each reservation only receive water for 160 acres?

In conclusion, I must quote my favorite passage from the 1902 law (U.S. Congress, p. 389).

> The said charges shall be determined with a view of returning to the reclamation fund the estimated costs of construction of the project, and shall be apportioned equitably: *Provided*, that in all construction work eight hours shall constitute a day's work, and that no Mongollian labor shall be employed thereon:

To me, the last proviso emphasizes the inappropriateness of strict application of a 1902 law to issues and problems of today. The major beneficiaries of the law will not be landless farm workers. They will be Bureau personnel needed for "detection and correction of . . . violations" (Bureau of Reclamation 1978, p. 28) and the large corps of lawyers required for the inevitable court challenges.

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Reclamation Policy and the Water Subsidy: An Analysis of the Distributional Consequences of Emerging Policy Choices

E. Phillip LeVeen and George E. Goldman

The goals of the 1902 Reclamation Act have always been the development of irrigated agriculture and enhancement of the "family farm." Although administrative procedures and institutional arrangements have changed over the years, these goals have remained in explicit or implicit form. However, there has been little discussion of the cost of irrigation and rural development policies or of how efficient and equitable they are in their present state. Recent proposals of the Department of the Interior would enforce more strictly the seventy-five-year-old 160-acre restriction for recipients of federally subsidized water in order to keep farming in Reclamation projects still economically viable while at the same time promoting smaller units of production than now exist. Large farm operators and owners of "excess land" oppose these new regulations as inequitable and destructive of efficient agriculture. Their view is that changing enforcement of the law at this time would be unfair. Land reform groups insist that administrative procedures be reformed to force a strict conformity with acreage and residency provisions and that the subsidy be used to support the development of modest-sized, family farms. The debate over future Reclamation policy revolves around the issues of farm-size efficiency and equitable distribution of the water subsidy. Interestingly most of the published research has concentrated on the questions of efficiency and viability (Hall and LeVeen, USDA, Goldman et al.). This paper examines the water subsidy in Reclamation irrigation projects, its magnitude and distribution under current administration of the law, and under proposed changes.

The Magnitude of the Water Subsidy

Congress originally intended there to be very little subsidy in the Reclamation program. Water users were required to repay full project costs, less interest, within ten years. However, Congress has extended the repayment period to forty years and permitted the use of hydroelectric power revenues to offset some of the costs allocated to irrigation development, thereby increasing the subsidy substantially. In recent years, inflation has reduced the repayments further by driving up the operation and maintenance costs (O and M costs) on projects, thereby reducing the revenues for repayment of construction costs. Water fees are fixed for forty years in advance and, at current repayment rates, only about 10% of the construction costs assigned to water users will be repaid. There is an additional subsidy to water users because the Bureau of Reclamation sells power to them for irrigation pumping at a much lower rate than they would have to pay to private firms for this power. In the Westlands, for example, these power subsidies amount to almost $15 million per year. The magnitude of this subsidy over all projects is unknown.

The importance of these subsidies to water users is illustrated in table 1, which provides estimated subsidies for the overall U.S. Bureau of Reclamation (USBR) program and for its most recent project, the Westlands Water District in the Central Valley Project. The overall subsidy estimate may be interpreted as the difference between what water users actually repay and what they would have to repay, were they required to purchase the complete projects today at their book value, plus interest during construction, less past repayments, and to amortize this investment over a forty-year period at 6.75% interest. This procedure understates the full subsidy in

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Table 1. Estimated Subsidies and Their Sources to Water Users in All Completed Reclamation Projects and in the Westlands Water District, 1976

	Annual Value of Subsidy 1976		Total Present Value of Subsidy 1976	
	All Projects	Westlands	All Projects	Westlands
	$ Millions		$ Billions	
Total project cost[a]	373	74.2	5.13	1.02
Total estimated subsidy	368	66.2[g]	5.05	.11[g]
Interest subsidy[b]	282	61.8	3.88	.85
Power subsidy[c]	39	—	.53	—
O and M inflation[d]	47	4.4	.64	.06
Underpriced power sales[e]	n.a.	(14.5)	n.a.	(.20)
	$			
Total subsidy per acre irrigated	35.04	161.40[h]	481	2,200[h]
Total subsidy per average farm[f]	2,530	355,080[h]	34,148	4,840,000[h]
Total subsidy per 160-acre farm	5,606	25,824[h]	76,960	352,000[h]

Sources: For overall project data, see U.S. Department of the Interior, Bureau of Reclamation; for Westlands Water District data, see U.S. Department of the Interior 1978, and LeVeen.

[a] Westlands data are not included in overall project costs because they are not considered completed. Costs include the value of all subsidies plus repayments anticipated.

[b] For subsidy on overall reclamation projects, interest is calculated at 6.75% over forty-year repayment period on $3.63 billion reimbursable construction costs and $1.50 billion interest during construction.

[c] Based on repayment of $1.54 billion of irrigation construction costs by power revenues.

[d] On overall Reclamation program, based on estimated repayments of irrigators, over and above O and M costs, equal to $.22 billion toward construction costs allocated to water users of $2.09 billion. In the Westlands, it is estimated that of total construction costs of $1.1 billion, water users will repay $.43 billion.

[e] For Westlands, based on a power rate of 2.5 mills per kilowatt hour (kw/hr) and a private commercial rate of 25 mills per kw/hr.

[f] Average farm size in Reclamation projects is 71 acres; in Westlands it is 2,200 acres.

[g] Does not include underpriced power sales subsidy.

[h] Does include underpriced power sales subsidy.

that it does not require users to repay interest on the unpaid balance of construction costs accrued since the first delivery of water. Since many projects have had the use of interest-free construction revenues for several decades, the true subsidy could be two or three times that estimated for the overall USBR program. The Westlands subsidy calculations, on the other hand, include all accrued interest costs, although these subsidy estimates are also probably understated because the project is incomplete and the future costs of some of its facilities are likely to be considerably higher than now anticipated.

The subsidy estimates indicate that only a small fraction of all irrigation costs are borne by water users, largely because of the interest subsidy. Were water users to repay the full costs of water, fees would rise to seventeen times their present levels on average throughout the program, and to about six times in the Westlands (LeVeen).

The Benefits of the Water Subsidy

Seventy-five years of administering and amending the Reclamation Act of 1902 have increased substantially the subsidy to water users. Nevertheless, such large subsidies might be defended on the grounds that they create even larger economic benefits or that they are used to promote widespread economic opportunity and a desirable form of agricultural development.

Irrigation projects increase the productivity of land and hence its economic value, but there is no necessary dollar-for-dollar relationship between the increased economic value and the public costs of a project. In some projects the economic benefit may be considerably greater than the public investment, and the provision of a public subsidy simply increases landowner benefits by transferring income to them from taxpayers. In other projects, the public costs may exceed the benefits of increased land productivity, and, were it not for the transfer of income from taxpayers to landowners, such projects would not be economically and politically feasible.

From the great difficulty water users had repaying project costs during the first forty years of this century, when they were liable for full repayment less interest (Swain, pp.

73–95), it might be concluded that few Reclamation projects are efficient. However, judging from the differences in the values of rents of irrigated and nonirrigated western land, the average $490 per acre public investment has produced benefits in excess of costs. Nevertheless, looking at the Westlands Water District which provides water to 545,000 acres, we find that a public investment of over $2,200 per acre creates benefits of less than $1,000 per acre (LeVeen, pp. 9–11). More than half the public cost is lost to inefficiency.

It could be argued that even though Reclamation projects may not meet the standard investment criterion of profitability, they may still be justified in terms of other policy goals related to the promotion of rural development, based on family farm agriculture. However, in many instances these broad social goals are not being met. The example of the distribution of the benefits created by the subsidy in the Westlands Water District underscores this point.

The development of any water project creates windfall benefits. The question is: how are these benefits captured and used? Benefits are usually captured by any landowner who purchased land for a price not reflecting the increased productivity of the land with project water. If the landowner is allowed to sell the land for its full, unconstrained market value, he will capture the entire windfall benefit, since any new buyer will take the additional productivity into account in making an offer to buy. The new owner will receive no windfall benefit to his income or wealth as a result of the project and if the subsidy were to be withdrawn would incur an uncompensated windfall loss. The original owner receives a windfall benefit even if he continues to own the land, for his annual income will rise as a consequence of greater productivity. Therefore, the only way the original owner can be prevented from capturing any windfall project benefits is to force him to sell his land prior to water deliveries at a price not reflecting project benefits. This was not done in the Westlands, nor in any other recent Reclamation project.

At the time of first water deliveries to the Westlands in 1968, there were 2,500 parcels of land under separate ownership (Jamieson, pp. 243, 247). In some cases the same individual or corporation owned different parcels, so the actual number of owners was probably less than 2,500. Of the 545,000 acres in the District, about 109,000 acres, owned in parcels of 320 acres or less by about 2,220 individuals and corporations, were classified as "nonexcess" land. The remaining 435,000 acres, owned by 280 or fewer individuals and corporations, were classified as "excess" land, and owners of this land who wanted project water were required to sign "recordable contracts" with the federal government agreeing to sell their holdings in excess of 160 acres (320 acres for a husband and wife) within ten years at a price set by the Secretary of the Interior not to include project benefits. Approximately 365,000 excess acres were entered under such contracts. Owners of the remaining 70,000 excess acres continued to rely on more expensive groundwater and remained free of all regulations even though they received project benefits indirectly through the effects of surface water deliveries on increased groundwater supplies.

Sale of nonexcess land is not required but is permitted under current administrative practices at full market price. Therefore, it is assumed that these owners captured the full windfall benefits which amounted to about $49,000 per owner (expressed in 1976 present value). It is important to note that most of these owners should be classified as "absentee investors" rather than as family farmers. There were virtually no small family farms in the District in 1968. Instead, there were a total of ninety-seven farms, averaging 4,500 acres each (U.S. Department of the Interior, 1978, p. 196). Most of the land in small holdings was leased to these large units, an arrangement made possible by the long-standing administrative decision not to enforce any kind of residency requirement (still on the books) which requires water recipients to live on or near their land.

About 63% of the excess land under recordable contract will be held for the complete ten-year grace period allowed by the contracts. Landowners therefore receive windfall benefits for ten years. Moreover, because of an administrative procedure which allows construction cost repayments to be deferred until final project completion, the present water charges do not include repayment contributions for about two-thirds of the project, even though the project is fully operable. This deferral increases the windfall benefits during the initial years of the project and increases the share of the windfall benefits available to the original owners. At the end of ten years, the land is sold at prices averaging about $750 per acre. The true land price without project water is believed to be closer to $350 per acre (U.S. Department of the Interior 1978, pp. 203–205). Therefore, the lenient assessment procedures, combined with ten years of project benefits, augmented by deferral of repayment assure that the original landowners will receive virtually the entire windfall benefit of about $1,000 per acre (LeVeen).

About 37% of the excess land under recordable contract was sold prior to the expiration of the ten-year period. The owners of this land did not give up their share of the benefits of the project, for it appears likely that they evaded land price controls and captured the full benefits by selling their holdings at unconstrained market value (Weiman; U.S. Department of the Interior, 1978, p. 193). In some cases, land was sold to employees of landowners and later, after employees defaulted, the original owner foreclosed on his loan and retained ownership and control over his land (U.S. Department of the Interior, 1978, p. 200).

In summary, owners of excess land captured most, if not all, of the windfall project benefits. The value of this benefit averaged approximately $1.45 million per owner. Excess landowners who did not sign recordable contracts realized smaller benefits from better groundwater supplies.

In 1977 half of the Westlands was classified as nonexcess land and there were 216 farms in the District, 119 more than in 1968. The new farms averaged more than 1,400 acres each, and if the remaining excess land is similarly subdivided, no more than 350 to 400 farms will be located in the District when the last of the recordable contracts expire in the early 1980s. In short, the public has spent over $1 billion to create, at most, 300 to 350 farms. Not only have the windfall benefits accrued to a very few individuals, but also the subsidy will have been used to create economic opportunities for a very few new farmers.

The example of the Westlands is extreme. The benefits of other projects in regions of the West, where initial landownership patterns were not as concentrated as in the Westlands, were doubtless more equitably distributed. Nevertheless, the Westlands is an appropriate example because it illustrates the weaknesses of many of the current procedures used to allocate subsidy benefits. Moreover, almost all of the 1.1 million acres still classified as excess land is in California under similar concentration of ownership as in the Westlands.

Proposed Changes in Reclamation Policy

In the current session of Congress, bills have been introduced to repeal and amend the acreage and residency requirements, and within the last year the Department of the Interior has twice recommended major revisions of current policy. The proposed changes would affect the distribution of benefits in the Westlands in the following ways.

Strict enforcement of the existing law. Following the key provisions of two U.S. Senate bills (S.1812, S.2925), we assessed the effect of eliminating many of the administrative practices adopted in the past fifty years. Under these bills, all excess land would be sold prior to water deliveries at the true nonproject price. Such a provision would effectively limit the ability of the original owners to capture project benefits. Since residency would be required, leasing arrangements would be eliminated, so absentee investors could not continue to own land, even if they presently own 160 acres or less. Families would be permitted to own no more than 320 acres, so the maximum windfall benefit allowed anyone would be $320,000, or about $20,000 per farm per year, in addition to normal return on management and labor of about $20,000 per year (LeVeen, p. 24; Goldman et al.; USDA). Land prices would be restricted indefinitely, so these benefits would remain within the project and could not be captured by any single family in one generation. Under such regulations, the Westlands could have been broken up into at least 1,500 family farms. Provision of a random mechanism to allocate excess land would have ensured would-be farmers a more equal chance to obtain subsidy benefits.

U.S. Department of the Interior proposals. The proposed regulations of August 1977 (U.S. Department of the Interior 1977) and the modifications proposed in May 1978 would enlarge the acreage restriction to 640 acres per family, and allow an additional 320 acres of leased land per farm. Residency would be required of all landowners. The period for disposing of excess land would be shortened from ten to five years, new standards to ensure better land value assessments would be employed, and buyers would be determined by some random method. Nonexcess land could not be sold for market value until at least ten years after purchase.

These regulations would reduce the capture of windfall benefits by the original owners by at least 50%. Restricting leasing and imposing residency would affect a profound change in the structure of farming in areas like the Westlands. The increased access to land would be aided further by the proposed lottery and the number of resident family farm operators would be perhaps as many as 500. However, the benefits still would be relatively concentrated, because the purchaser of a typical 640-acre parcel of excess land would be able to capture $332,000 in windfall benefits, in addition to about $81,000 annual return for labor and management (USDA, p. 18; U.S. Department of the Interior 1977).

Final Comments

Of the various proposals examined, only strict enforcement of the existing laws would provide a substantially wider distribution of the subsidy benefits. Yet the benefits associated with a 320-acre farm in the Westlands, assuming the land purchase price of $350 per acre, would still be over $20,000 per year in addition to the usual return on family labor and management. Considering the one billion dollar public expenditure involved, the fortunate families who received such farms would be relatively few in number—less than 1,400 in a region the size of Rhode Island. Though such an expenditure might change the present agricultural system, it is unlikely that it would stimulate substantial rural development or make significant reductions in rural poverty.

It might be argued that making the acreage restriction smaller would provide more economic opportunities and distribute the subsidy to a larger group. Yet, if farm size were restricted much below the 320-acre limit, additional subsidy would be needed simply to offset rising production costs (Hall and LeVeen). Greater coordination between farmers to reduce the impact of diseconomies of small size has been suggested, but such a solution, while theoretically feasible, would require a major shift in the orientation of agricultural support systems and in the attitudes and expectations of farmers. It would raise legal questions concerning the right of the landowner, especially those who do not want to participate in cooperative schemes. Finally, it would imply a very costly administrative planning mechanism to set up and maintain such a system. These obstacles would appear to be larger than most proponents of land reform would be willing to admit.

Thus future Reclamation policy faces an important dilemma. For existing projects, the majority of subsidy benefits have been captured and capitalized into land values and could not, even under the strictest regulation proposals, be totally recaptured and made available to new settlers. Imposition of new regulations which force the sale of land at pre-project value would impose significant and uncompensated welfare losses on many who purchased the land at prices which included project benefits. Imposing residency requirements and restricting leasing could bring about a major change in the nature of farming in many districts, increasing the number of owner-operator units and diminishing farm size. However, changing a seventy-five-year-old administrative practice would impose economic costs on those who purchased land under the expectation that these regulations would continue, and this raises an issue of fairness.

In conclusion, the linking of water resource development with rural development has not led to a wide distribution of project benefits to new farmers. Even if the new regulations prevented most of the project benefits being captured by current landowners, and even if they were written so as to achieve the widest possible distribution consistent with efficient technology, the number of beneficiaries would be relatively small. There may well be alternative policies, using the same amount of public expenditure, which could more effectively promote family farming and rural development.

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Demographic, Economic, and Fiscal Impacts of Alternative Westlands Reclamation Act Enforcement Scenarios

Peter L. Bass and Edward M. Kirshner

California's Westlands Water District is now the center of national debate on the effect of federal reclamation law on the development of agriculture in the western states. Proposed changes in the law or its enforcement could have significant effects on the economic, social, and political structures of many western communities.

While there has been much discussion of the potential impact of reclamation law changes on agricultural efficiency and farm viability, the relative costs and benefits of local community impacts that might occur have been largely absent from the debate. These considerations should be explored and weighed in any evaluation of different Reclamation Act enforcement scenarios.

The questions of community impact and basic equity are central to reclamation law. Its legislative history indicates that congress intended to:

> "—provide opportunity for a maximum number of settlers on the land and to promote homebuilding;
> —spread the benefits of the subsidized irrigation program to the maximum number of people; and
> —promote the family-size farm as a desirable form of rural life." (USDI, p. 193)

Furthermore, the magnitude of public subsidy for reclamation projects is now truly enormous. In the Westlands, the present value of just the forgiven interest payments is projected to be greater than the present market value of all the irrigated land in the District (USDI, p. 39). Small farm viability in the District has been resolved in large part because of these subsidies and the likely sale of land at a price excluding project benefits. A recent study by USDA (p. 18) estimates that in the Westlands an annual return to management and operator labor would be $25,000 on a 160-acre farm, $54,000 on a 320-acre farm, and $81,000 on a 640-acre farm.

The original supporters of Westlands subsidy legislation agreed with the congressional intent to share these benefits, predicting an area influx of 87,500 people with family farms averaging about 100 acres (Sisk). Public policy requires and equity demands that the benefits of western irrigation projects be widely and directly distributed.

In this paper we summarize some preliminary findings on projected demographic, economic, and fiscal changes that might occur to the year 1990 under different enforcement schemes in the Westlands Water District. Studying these potential community impacts in the Westlands is of particular value because of the scale of the District, and the dominant role that agriculture plays in the local economy. Our intention is to analyze comparative community viability beyond the dubious issue of efficiency (SFVP, Technology Task Force, appendix A) and the limited question of farm viability.

Enforcement Scenarios

We have postulated four levels of enforcement of the 1902 Reclamation Act provisions regarding farm size, residency, and land price. These scenarios range from a combination of current trends (essentially nonenforcement, leaving large corporate farms as the prevalent production mode) to active encouragement of a fully mature, small family farm economy. All farm cases represent real options advocated by one or more groups. Salient features of the enforcement scenarios are summarized in table 1.

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Table 1. Four Reclamation Act Enforcement Scenarios in the Westlands Water District

Aspect	#1 Present Trends (nonenforcement)	#2 Limited Enforcement	#3 Strict Enforcement– Medium Size Farm	#4 Strict Enforcement– Small Size Farm
Acreage assumed subject to redistribution[a]	375,000	419,000	544,000	544,000
Maximum permissible farm operation	Essentially unlimited	1,280 acres (owned & leased)	640 acres	640 acres
Effective average farm size	About 1,300 acres	640 acres	200 acres (allotted sizes range from 20 to 640 acres)	100 acres (allotted sizes range from 20 to 640 acres)
Eligibility	Anyone	Anyone	Lottery	Lottery
Residency restrictions	None	50 miles from farm	15 miles from farm	15 miles from farm
Land price (including improvements)	$1,500/acre	$1,000/acre	$750/acre	$300/acre (minimal improvements)
Description	Corresponds to recent practices. Encourages continuation of large-scale corporate farms. Similar to Westlands Owners' position.	Approximates recent Department of Interior proposals for changes in law and/or enforcement. Does not encourage smaller family farms.	Represents a serious attempt to follow original objective of 1902 Act, establishing small family farms. Approximates recommendations of National Land for People (NLP).	Maximizes small farm opportunities. Similar to position of original Westlands proponents and preferred by NLP.

[a] Varies depending upon interpretation of "project benefits" and whether past excess land sales will be upheld. (See UCLA, p. 26.)

Population and Employment Impacts

Reorganization of the Westlands economy towards one that centers around smaller family-owned and operated farms is projected to increase the permanent population and employment base within the District and near its boundaries (referred to here as the "Study Area," see UCLA, p. 2). Each successive movement towards smaller farm size results in increases in the Study Area's resident owner-farmer population and nonagricultural support population, with some offset caused by declining demand for year-round permanent for-hire labor. These population/employment effects are summarized in table 2. In moving from the Present Trends to the Strict Enforcement Scenario, Study Area population and employment would more than double.

The progressive increases in population and employment outlined in table 2 result from several factors.

Table 2. Summary of Employment, Population, and Households Supported in the Study Area under Each Scenario

	1 Present Trend	2 Limited Enforcement	3 Strict– Medium Farm	4 Strict– Small Farm
A. Resident Employment (Permanent)				
Farmers	300	800	4,100	5,400
Farmworkers	3,200	2,900	700	—
Nonagricultural	2,900	3,700	7,700	9,400
Total	6,400	7,400	12,500	14,800
B. Population in Study Area	15,900	18,700	32,000	40,000
C. Households	4,000	4,800	8,200	9,800

Stricter maximum farm-size and residency requirements would result in more farmer households living in the District. The increase from Present Trends to the Strict Enforcement Farm Scenarios is estimated at more than fifteenfold.

While the need for year-round, permanent field hands virtually disappears in the Strict Enforcement–Small Farm Scenario, the gain in owners living in the District caused by the residency requirements would more than offset this loss. (Depending on the method of land distribution, many of these farm laborers would become owner-operators or service sector workers.)

A more equitable distribution of income (resulting from the great number of smaller units, as outlined in the next section) results in higher expenditures for consumer goods and services. Combined with the much larger resident farm owner population and the greater demand for locally produced agricultural inputs, this in turn increases secondary, nonagricultural population and employment in the Study Area.

Household Income

A move toward smaller farms in the Westlands would increase the amount of household income generated and spent in the local economy and result in a more equitable distribution of income among households (table 3). Local income generated by resident farm-owner households is projected to increase more than tenfold in moving from the Present Trends to the Strict Enforcement–Small Farm Scenario. In part, this depends upon a sale price for land not reflecting project benefits.

The substantially greater recycling of income in the local community produces multiplier effects that would continue to generate increases in nonagricultural jobs and household income beyond the year 1990. Furthermore, as farm size decreases there is a progressive increase in the number and proportion of middle income households earning $15,000 to $35,000 a year.

The rise of a broad, middle-income population suggests both a stronger and more dynamic local economy and more stable communities offering a broad range of services. These trends are supported by recent comparative socioeconomic studies of community structure in areas surrounded by small farms and large farms, respectively (see Fujimoto, and SFVP, Community Services Task Force).

Impact on Local Retail Sales

Development of family-operated small farms in the Westlands would result in a major increase in the volume of retail sales transacted within the Study Area as well as the number, size, and diversity of retail establishments. This, in turn, would increase retail employment in the area as well as in the rest of Fresno County. The trend can also be attributed to the greater amount of household income that will be generated in the local economy, and its more equitable distribution (table 4).

The small number of households now in the area are geographically scattered and have low aggregate buying power, which limits the number of stores that can serve the area and the variety of merchandise they carry. Under the Strict Enforcement-Small Farm Scenario, household income and the aggregate potential market increase substantially. Income is also distributed among a much greater number of

Table 3. Household Income of Westlands Residents (in millions of 1978 dollars)

	1	2	3	4
	Present Trends	Limited Enforcement	Strict–Medium Farm	Strict–Small Farm
Income up to $50,000/year/hh				
Farmers	$11	$29	$ 84	$133
Year-round farmworkers	22	20	5	—
Nonagricultural households	29	37	77	66
Total	$62	$86	$166	$199
Excess income over $50,000/year/hh	$32	$ 7	—	—

Note: Basic farm household incomes were derived from USDA; year-round farmworker jobs were assumed at $7,000/year with an average household income of about $12,000/year (1.75 jobs/household); nonagricultural jobs were assumed at $10,000/year with an average household income of about $15,000/year (1.5 jobs/household).

Table 4. Consumer Retail Sales in Study Area Generated by Local Residents under the Alternative Enforcement Scenarios (in millions of 1978 dollars)

	1 Present Trends	2 Limited Enforcement	3 Strict–Medium Farm	4 Strict–Small Farm
	$			
A. Basic local gross income of Study Area residents (from table 3)	62	86	166	199
B. Total retail expenditures[a] (50% of line A)	31	43	83	100
1. Food sales[a] (12% of line A)	7	10	20	24
2. Other retail sales[a] (38% of line A)	24	33	63	76
	%			
C. Percentage of sales spent in Study Area stores				
1. Food sales	80	85	95	95
2. Other retail sales	15	20	55	60
	$			
D. Total Study Area retail sales	10	16	54	69
1. Food (B.1 × C.1)	6	9	19	23
2. Other (B.2 × C.2)	4	7	35	46
E. Square footage of stores	95,000	155,000	590,000	770,000
1. Food ($150/sq ft)[b]	40,000	60,000	125,000	155,000
2. Other ($75/sq ft)[b]	55,000	95,000	465,000	615,000
	$			
F. Sales in remainder of region	21	27	29	31
1. Food	1	1	1	1
2. Other	20	26	28	30

[a] USDL.

[b] Urban Land Institute.

households, each with a higher average propensity to consume than fewer, wealthier families (USDL). As local retailers improve inventories and new shops open to meet this demand, a far smaller proportion of sales will be "leaked" from the local district to more distant areas such as Fresno.

Select Fiscal Impacts on the Town of Huron and its Related School District

Our studies have indicated that strict enforcement of the 1902 Reclamation Act in the Westlands would result in substantial population growth, along with a more equitable distribution of income. A key question is whether local communities can afford the costs of improvements and services such growth implies.

A complete analysis of the fiscal impacts associated with enforcement of reclamation law is beyond the current scope of our research. However, we have evaluated the projected fiscal impacts (pre-Proposition 13) of two enforcement scenarios on the town of Huron and its school district (Coalinga Unified) as an example of the methodology for conducting such studies, and to explore the relative impact of Present Trends versus Strict Enforcement of the law.

Huron is the only incorporated town lying completely within the Westlands Water District. Because of its location and current function as a market and service center, Huron could be expected to show the largest population growth as a result of development of smaller farms in the Westlands (UCLA).

Summarized in brief, the population added in the Strict Enforcement-Small Farm Scenario is projected to be significantly greater than in the Present Trends Scenario and would live in lower density, more expensive housing because of the greater proportion of higher income farmers residing in the town. The commercial sector would also expand significantly due to the much larger retail sales potential generated by the household population in and around the town (table 5).

Table 5. Summary of Fiscal Impacts on Municipality of Huron and Coalinga Unified School District under Two Enforcement Scenarios

	#1	#2
	Present Trends	Strict Enforcement–Small Farm
1. Development summary		
Added population—#	1,770	5,000
% over 1976–77	74	209
Added housing units	490	1,440
Average density new housing	4.5/acre	3.5/acre
Added developed acreage (residential, commercial, other)	133 acres	540 acres
2. Municipal costs		
Added capital development cost	$2,010,000	$7,740,000
Added bonded indebtedness	1,150,000	5,220,000
Added operating costs[a]	390,000/yr	1,110,000/yr
Increased revenues (non-property tax based)	380,000/yr	1,220,000/yr
Net operating cost increase	$ 10,000/yr	<$ 110,000/yr>
3. Projected property tax impact (pre-Proposition 13)		
Current rate[a]	$3.60/$100 A.V.	$3.60/$100 A.V.
Projected rate (1989–90)	$2.70/$100 A.V.	$2.00/$100 A.V.
Projected bonded indebtedness as % of assessed value	24%	29%
4. School district impact (pre-Proposition 13)		
Assessed value/student[b]	$53,280	$53,280
Added assessed value/student (1978–90)	$ 7,200	$11,500
Property tax rate[b]	$2.60/$100 A.V.	$2.60/$100 A.V.
Imputed tax rate increases (1990)	$ .52/$100 A.V.	$1.03/$100 A.V.
5. Combined city/school district tax rates		
Before expansion	$6.20/$100 A.V.	$6.20/$100 A.V.
After expansion	$5.82/$100 A.V.	$5.63/$100 A.V.

[a] State Controller, *Cities of California*.
[b] State Controller, *School Districts of California*.

As indicated in table 5, added capital and operating public costs would be involved in developing and running the additional infrastructure and services needed in the expanding town. We have deliberately assumed no change in the basic per capita level of services provided as the town expands. This is done to prevent confusion between public costs due to expanding services for added population and those costs resulting from service upgrading.

Projected increases in municipal revenues from all sources other than property taxes and special purpose federal and state grants are expected to almost match estimated cost increases. This occurs because of the disproportionate increase in sales tax receipts from the town's expanded commercial role, and because of surpluses from municipally-owned sewer and water enterprises. As a result, the amount of additional revenue needed to be raised via the property tax (mainly for paying off added bonded indebtedness) increases at a rate slower than added assessed value, allowing for a significant drop in property tax rates. However, it should be noted that during the development phase the town's total bonded indebtedness exceeds the legal limit allowed in relationship to assessed value (15%), which would require the municipality to develop special, more costly financing approaches (e.g., revenue bonds, improvement, or special assessment districts).

The school district containing the town of Huron would face less favorable fiscal impacts than the city government under the added growth implied in either of the two scenarios evaluated. As shown in table 5, future increases in student population occur faster than assessed value gains. Since approximately the same amount per student would still have to be raised via property taxes, this implies higher future tax rates. While the Strict Enforcement–Small Farm Scenario, on a per-added student basis, has less marginal impact, the far greater number of added students results in a greater aggregate impact on the projected tax rate. It should be noted, however, that even with higher school district rates, the combined city/school district rates would decrease with town expansion as contemplated under the two scenarios. The savings are more pronounced for the smaller farm economy.

The effect of Proposition 13 (the Jarvis-Gann Initiative) on the property tax rate will be dramatic. The present and projected aggregate tax rates for Huron will have to be reduced by about 60% to $4 per $100 assessed value (plus about $.20 per $100 assessed value for existing debt service). Major adjustments in Proposition 13 or major new sources of revenue will be required to at least partially make up for these reductions if local governments are to operate at all effectively. However, of the enforcement scenarios, we would expect the Small Farm option to fare the best in terms of fiscal feasibility due to its relatively greater tax base (sales, income, employment, etc.).

Conclusion

Our analysis of four proposed levels of enforcement of the 1902 Reclamation Act provisions indicates that the Strict Enforcement–Small Farm Scenario is both the most feasible and the most equitable. We project significant comparative increases in population, employment, income, retail sales, tax base, and fiscal feasibility under this scenario. We believe strict enforcement of the Reclamation Act would produce a more viable local community and a more equitable income distribution than any of the other proposed alternatives. In addition, strict enforcement of the law comes closest to fulfilling the original intent of the Congress.

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Discussion

David Holland

These remarks will be directed mainly to issues raised in Martin's paper. There are two reasons for this. First, Martin sent a well-documented copy in plenty of time to allow for reading and thinking. Second, Martin raises some points on which I feel rather uncomfortable and would like to see further professional attention focused.

I would like to begin elaborating on one of the points in Martin's paper in which I believe we are mainly in agreement. Martin is suspicious of Bureau of Reclamation estimates of farm land ownership, arguing that Bureau data is difficult to reconcile with primary data with which he is familiar.[1] I have also come to suspect the validity of much of the land ownership information that is available for that reclamation area with which I am somewhat familiar—the Columbia Basin of Washington state. In addition to the obvious incentive of large land owners to disguise the truth, the responsibility for keeping track of excess land apparently has been passed from the Bureau to individual irrigation districts. The management of irrigation districts often tends to be much more subject to large landowner influence, and is not especially inclined to pursue vigorously a rigorous and reliable land ownership record. Also, there does not seem to be consistent cross-tabulation of ownership records between irrigation districts. For both of these reasons it is my hypothesis that current estimates of excess ownership are biased substantially downward. Enforcement of the ownership portion of the current law may involve considerably greater acreage than existing estimates of excess lands would indicate.[2]

In his discussion of economies of size, Martin provides a brief review of some of the available literature and concludes that economies of size do exist, and that they are one factor in explaining the presence of large farms. Next it is argued that depending upon management ability and equity position of the farmer, small farms are viable, and thus, at least as I read it, questions regarding small farm viability are not very interesting. While I agree with Martin that small farms can be viable, I also think the issue of viability is a fairly important component of needed research regarding enforcement of Reclamation law. Essentially, the politics of the reclamation issue have placed viability on the research agenda. Also, as I have previously argued, the conventional economic accounting framework, while appropriate for allocative efficiency questions, is not a very useful framework for looking at viability. This framework neglects the importance of income taxes and fails to track returns to equity to their final destination. Thus, income available for family living expenses is underestimated for low income farms and overestimated for high income farms. A more useful framework is the cash accounting model which can provide a much closer approximation to the real world and, therefore, a better estimate of viability.

While I do not have much quarrel with Martin's review of the economies-of-size literature, I am concerned about the credence he appears to place in it. In my experience the conventional wisdom on size economies in agriculture is a little like Bureau estimates of excess acreage; the closer you get the more suspect it becomes. Many of the studies are considerably dated, often ranging from one to nearly two decades old. More important, most of the available work is flawed both methodologically and empirically.

It is my feeling that most studies of multiple crop farms have become so enamoured with the economic engineering models that they have failed to spend sufficient time in the field corroborating the critical assumptions under-

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[1] In discussing land ownership in the Columbia Basin of Washington, Martin slips into an error when he states that "3% of the irrigated land was in farms averaging more than 1,000 acres (USDA)." A correct statement is that 3% of the farms which were operated in 1973 were 1,000 acres or greater. Such farms constituted 13% of the irrigated land in the Columbia Basin.

[2] Detection of the actual distribution of land ownership in Reclamation projects is probably not the sort of thing university researchers can do very well. Such a job is probably best left to a federal investigative agency—not a very pleasant thought.

lying such models.[3] For example, nearly every study with which I am familiar assumes that yields are invariant with farm size. I strongly suspect that this is not true. My guess is that significantly smaller yields characterize larger farms, the phenomenon being a manifestation of managerial diseconomies. In general, the budgets depicting crop production on both very small farms and very large farms tend to be weak. More empirical work is needed to strengthen our understanding of production practices and yields for both very small and very large farms.

Another problem which has plagued previous economies-of-size studies is the assumption of a fixed machinery complement. Such an assumption incorporates a strong upward bias into cost estimates on the lower end of the operating range in that it effectively precludes the option of crop specialization for smaller acreages. To correct this problem machinery components should be allowed complete variation according to farm size.

While it is quite clear that machinery economies exist, I would also argue that this component has received far too much attention leading to neglect of other equally important components of the issue. I personally remain unconvinced that technical economies are very important in agriculture. New and rigorous work is needed here to firm up our understanding of economies and diseconomies of size for multiple output firms.

In examining the consequences of land reform, Martin argues that if land reform were really effective the supply curve for agricultural output would shift upward and to the left. The result would be decreased ouput and higher price. Assuming a price flexibility of −2.0 at retail and a 1% decline in quantity, Martin calculates a $5.2 billion loss in consumer surplus. While we could quibble over the magnitude of the resulting output change, where I am afraid Martin has gone wrong is in the expected direction of change.Martin may have assumed that effective reform would drive many formerly optimally sized farms to a less-than-optimal size, thus causing the industry supply curve to shift to the left. Such an argument rests rather implicitly upon the shape of the long-run average and marginal cost curves, which I have argued are largely an unknown quantity.

The evidence with which I am familiar indicates that agricultural output (measured as total revenue) per acre tends to fall as farm size increases. There are several reasons for this. As farm size measured in acres increases, it becomes necessary that the farm shift out of more labor-intensive crops into those crops which are compatible with extensive mechanization. This usually means a shift toward enterprises which are relatively low-valued.

Another factor leading me to suspect higher output per acre on the smaller units relates to the more efficient managerial control which should characterize such units. This fits roughly into the X-efficiency notion of Leibenstein which is often associated with large changes in output.

Finally, in the international development literature where land reform has been much studied, the general view is that land reform, if it does anything, will increase output. For example, Johnston and Kilby state, "There is now a general consensus that almost never does land reform decrease production, occasionally it has a neutral effect, most often it has a positive effect" (p. 162). Contrary to Martin, I think there are rather persuasive reasons for thinking that one consequence of an effective land reform would be to increase rather than decrease consumer surplus.

Kirshner's paper presents an example of precisely the sort of study that I think is of vital importance in dealing not just with development of the Westlands Water District but also the broader issue of U.S. agricultural development. It provides potentially very useful information by attempting to relate alternative agricultural size-structural distributions to corresponding demographic and economic consequences. Unfortunately, while I greatly admire Kirshner's approach, I cannot speak to the validity of his findings. The paper I received was not sufficiently well documented to provide an adequate assessment of either data sources, necessary assumptions, or required calculations.

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Leibenstein, Harvey. "Allocative Efficiency vs. X-Efficiency." *Amer. Econ. Rev.* 56(1966):392–415.

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[3] The early and excellent study by Carter and Dean in Yolo County is an exception to this criticism. While containing some questionable assumptions and empirical procedures it makes repeated reference to survey data and findings.

Discussion

Robert K. Davis

The first point to clarify is that the Secretary of the Interior's proposed excess lands policy, as contained in H.R. 13473, is different in a number of respects from the policies addressed by Martin in his paper.

The acreage which can be eligible for Reclamation water in the Secretary's proposal is limited to 480 acres per adult individual, of which not more than 320 acres can be owned and which any two adults can combine for a unit of 960 acres. Owners of excess lands would have ten years to sell under a recordable contract to preferred categories of buyers. The preference categories would be the immediate family, tenants and employees of at least ten years' longevity, and adjoining neighbors. If a preferred buyer has not been found in the ten-year period, then the Secretary assumes powers of attorney and will sell by a lottery whose details remain to be specified. The selling price will be controlled at the first sale and fifteen years beyond.

The Secretary's proposal specifies a residency requirement fifty miles or less from the tract and owners will be required to be substantially involved in the farming operation. Multiple ownerships will be permitted if limited to spouses, brothers, and sisters in a direct lineal relationship, and all multiple ownerships will be held to the 960-acre limit. No entity can own acreage eligible for water in more than one irrigation district.

Martin's analysis is based on the August 1977 proposal. The latest proposal will change his conclusions, most importantly, I think, by singling out the nonfamily corporate farms and lessees for conformance within five years and also by requiring an end to ownership in more than one irrigation district.

Martin casts doubt on our ability to untangle confusion in the information which one collects on farm ownership and size of farming operation. One can wish that Martin would draw the issues out a little finer here. If there is no reconciliation of the discrepancies in this kind of information, then there are serious questions about our ability to administer any excess lands policy.

Martin's assumption that a 1% decline in quantity of output will ensue from the imposition of the 160-acre limit ignores the possibility that first-round partial equilibrium analysis overestimates the impacts of such a regulation. After having looked at a number of studies of the impact of regulation on industry, I am convinced that by the time an industry adjusts to a constraint, the efficiency costs are much less than those arrived at by aggregating the first round effects on the individual firms. Perhaps the best analogy here is with Lind's work on the effects of excluding certain productive uses from the flood plains. The loss is not that of the use excluded, but of some marginal use of some very low class land which is bumped in a series of adjustments.

The effects of ineffectiveness deserve to be developed more fully in Martin's paper. The question at issue here is what strategems are likely to be employed by those who are regulated to minimize the bite of the revised law and regulations. It is clear that the Secretary of Interior does not intend to create a host of new 160- and 320-acre farms, but he does want to eliminate the nonfamily and nonresident corporations and all large operations and transfer their lands soon to resident family operations of no more than 960 acres. If the new owners hire the machinery of the former operators but not their managership, then is that a circumvention of the rules? What games will the irrigation farmer invent and to what lengths will the federal government go with countermoves?

When one thinks down this path, he arrives at a general question concerning the effects of this process on the Bureau of Reclamation. New information files will have to be created and maintained covering the residency of owners and lessees, the family relationship of and changes in corporate ownerships, ownership in other districts, degree of involvement in farming, all sales of excess lands, all resales

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of excess lands for fifteen years after the first sale, ownership by lessees and leasing by operators, eligibility of purchasers, and others.

One might well ask what the information and enforcement costs will be of returning to the principles of the 1902 Act. One might also ask whether this return to the principles of the 1902 Act is going to radicalize the agency-client relationship that has developed between the Bureau and the irrigation districts. Is this the end of harmonious growth and development in federal irrigation projects?

Turning to the Goldman-LeVeen article one finds that they correctly identify the land sale and sale price as the key to controlling the distribution of the subsidy. It should not escape our notice that the 1902 Act is all about who should receive the subsidy. The question is can we control the distribution of the subsidy as one would use a flit gun on mosquitos?

By taking some liberties with their paper, one can devise the following rules for controlling the distribution of subsidy. (*a*) Limit the size of the windfall to the original landowner by forcing him to sell all excess land at the pre-project price prior to the delivery of water. (*b*) Extend excess land rules to all lands which benefit externally from the project. (*c*) Collect charges from the first water delivery instead of upon completion of the project. (*d*) Follow rigorous assessment procedures on price controlled sales.

Their analysis leads to a very troubling question: If all of the windfall gain (subsidy) has been captured in Westlands (and might be presumed to be captured in similar fashion on the remaining California excess lands), then are we going to be disappointed by the results achieved through the change in reclamation policy as regards the redistribution of the subsidy? Can the federal government devise a flit gun which works?

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Viability of Rural Communities
(Lee M. Day, Northeast Regional Center for Rural Development,
Ithaca, New York, Chairperson)

Rural Development Planning: A Science?

J. A. MacMillan and J. D. Graham

Low incomes and lack of job opportunities have been identified as problems for many rural regions in Canada. Large expenditures have been directed to overcome such problems. According to Lessard, $1.1 billion was spent on rural development programs in Canada over the 1961–75 period. In the planning process, a rural development plan refers to a set of programs that include integrated projects with a fixed budget set for a period of years.

It is our contention that simulation procedures exist which allow researchers to approximate a scientific test of the effectiveness of rural development planning. Simulation (Johnson and Rausser, p. 162) is a process of experimenting with economic models which has been applied to one plan in Canada (Tung, MacMillan and Framingham, and Brown and MacMillan). If a plan is viewed as a single experiment, a validated regional model can be used to simulate *ex post* results with the plan (a treatment) and without the plan (a control). A comparison of results with and without the plan completes a single test for a plan in one region. Several *ex post* experiments with different plans in different regions are required to complete the testing of rural development planning.

The critical issue is that agreement does not exist among economists and planners with respect to the common set of research procedures required to test the effectiveness of rural development planning. As a result, rural development planning as commonly practiced generates few recorded observations that are comparable.

Testing rural development planning is discussed below with respect to (*a*) a proposed definition of rural development-planning research steps; (*b*) a summary of research conducted for the evaluation of the rural development plan for the Interlake Region of Manitoba; (*c*) applicability of the research steps for rural development planning in British Columbia; and (*d*) observations on rural development planning.

A Proposed Definition of Rural Development Planning Research

It is implicit in our definition of research steps that the economist's role is to assist policy makers and administrators to make more effective planning decisions. Consider the null hypothesis—the rural development plan has no effect in achieving the development objectives. Many classifications of procedures exist for an economic research investigation. For example, twenty-three steps are outlined by Ferber and Verdoorn for solving a typical consumer research problem. Six research steps (fig. 1) are defined below as a guide in the testing of rural development planning.

(*a*) Identification is made of quantitative rural development objectives including measures of income and job opportunities and standards of living for residents of a rural region.

(*b*) A model is constructed for the rural region with the capacity to simulate estimates of aggregate regional indicators of development with and without the projects contained in the plan.

(*c*) Feasibility studies are completed to assess proposed projects relative to *ex ante* rate of return and income distribution performance criteria.

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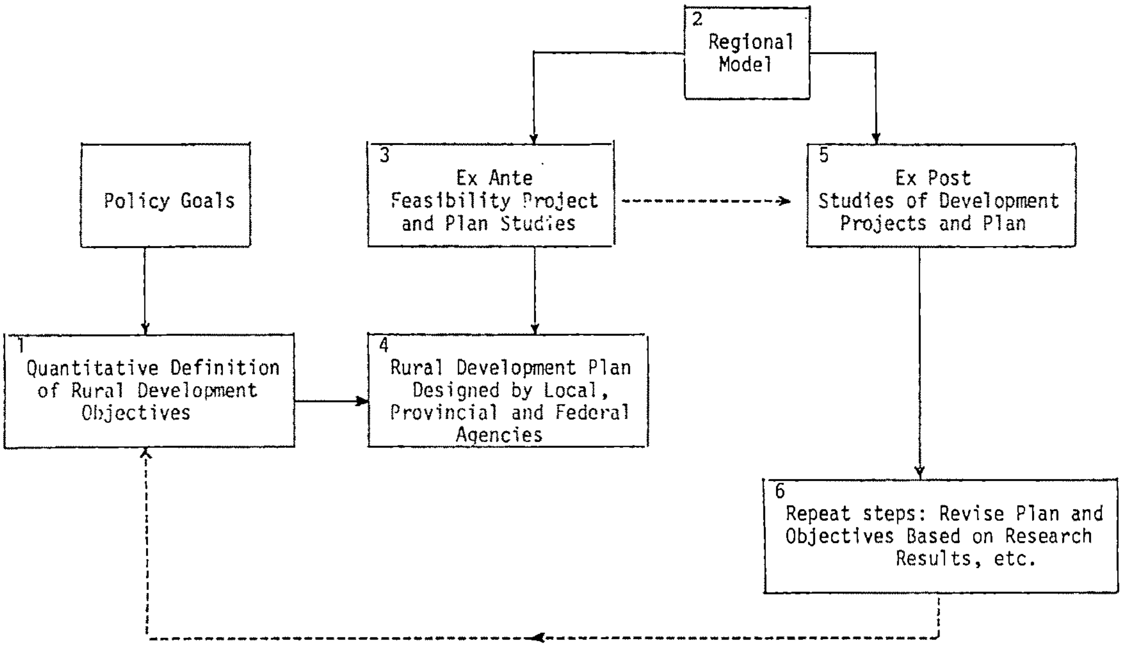
2 Regional Model
Policy Goals
3 Ex Ante Feasibility Project and Plan Studies
5 Ex Post Studies of Development Projects and Plan
1 Quantitative Definition of Rural Development Objectives
4 Rural Development Plan Designed by Local, Provincial and Federal Agencies
6 Repeat steps: Revise Plan and Objectives Based on Research Results, etc.

Figure 1. Rural development planning research activities

(*d*) A plan consisting of $X million on selected projects for a fixed number of years is constructed.

(*e*) In depth special studies of the development projects and plan are conducted to assess project results *ex post* relative to *ex ante* projections.

(*f*) Conclusions with respect to improvements in the plan and rural development objectives are made consistent with *ex post* study results.

Completion of all activities for a single plan generates one observation with respect to the effects of rural development planning. It is common for analysts to focus only on one of these six activities such as *ex ante* project analyses or sectoral models for a single development plan. While such partial analyses may be interesting and of value, all six activities are a prerequisite for tests of the rural development hypothesis. Ideally, several iterations of these steps would be completed in planning with continual interaction with the plan administrators.

It is recognized that rural development planning can be viewed from many perspectives including: political, administrative, sociological, ecological, and economic. Considerable scope exists for zero or negative economic impacts of plans due to noneconomic factors. Local involvement in specifying goals is one means of reducing noneconomic planning problems. The feasibility of obtaining statements of development goals has been demonstrated for two rural regions in Manitoba by MacMillan and for Treaty #3 Indian bands in northwestern Ontario by Kelly, Kelly, MacMillan, and Lyon.

Evaluation of the Rural Development Plan for the Interlake Region of Manitoba

A total of $85 million was allocated to a rural development plan for the Interlake Region of Manitoba for the period 1967–77. The objectives of the plan were to increase income and employment opportunities and to raise the standard of living of the people of the area. Programs were implemented in the areas of education, manpower training, agriculture, fisheries, transportation, and recreation.

The objective of research concerned with evaluation of the rural development plan for the Interlake Region of Manitoba was to measure the economic impact of the plan thus determining whether the broad objectives contained in the plan were being attained (see MacMillan and Lyon). Research results indicate the feasibility of estimating the effects of a rural development plan on indicators of rural development (Tung, MacMillan and Framingham, and Brown and MacMillan). *Ex post* in depth studies of projects were compared with *ex ante* feasibility results. Individual project impacts were linked to a dynamic simulation model for the rural region and projections for the region made with and without the plan. Conclusions were reached with respect to improvements in the plan as a consequence of study results. The evaluation research procedures for the Interlake Region were consistent with the six activities listed above.

Unfortunately, the six steps have not been completed for other rural development plans and there is a scarcity of consistent program evaluation results. For example, the cost effectiveness of programs in job creation range from $33,000 per job for highway expenditures to $6,000 per job for agricultural development and manpower corps (table 1). These results appear to be comparable to estimates for U.S. development programs (Tweeten and Brinkman, p. 436) including public employment ($36,000), industry location through tax writeoffs ($5,000–$12,000), subsidies to industry for training the disadvantaged ($6,000), subsidized migration ($3,000). Confidence that such job creation effects are generally applicable in rural development planning requires analysis of programs in many rural regions.

Rural Development Planning in British Columbia

Rural development planning in the Interlake Region of Manitoba started with several years being spent on feasibility studies prior to a specification of development goals and detailed projects in the plan (see Hordo and MacMillan for a review of management stages in the plan). The discussion of quantitative development objectives and feasibility studies currently being initiated in British Columbia is consistent with a preplan management phase in the evolution of a plan (steps 1, 2, and 3, fig. 1).

An opportunity exists in the Province of British Columbia to follow the research procedures outlined above. Under an agreement between the federal and provincial governments an expenditure of $60 million between 1977 and 1984 was authorized under an Agricultural Rural Development Act (ARDA). Four program areas are included: (*a*) research, planning, training, and market promotion ($4.95 million), (*b*) coordinated resource management (range improvement, $19.8 million), (*c*) primary resource development (irrigation and drainage, $15.0 million), and (*d*) support services and community development ($20.25 million). The agreement provides for local, provincial, and federal participation in the planning process, but a formal plan is yet to be formulated. Funds have been allocated to program areas with a minimum of completed economic analysis. A cursory review of the programs indicates a substantial proportion of the total budget is being directed to a small number of beef producers. Given this

Table 1. Job Creation per $1 Million in Alternative Rural Development Programs, Interlake Region of Manitoba

Sectoral Program	Man-Years Employment Created per $1 Million (1968 dollars)	Timing of Job Impact
1. Agricultural development[a]	160	Perpetual or Life of Drain
2. Food processing[b]	50	Perpetual
3. Education[c]	85	Annual Expenditure Required
4. Housing[d]	80	Annual Expenditure Required
5. Highways[e]	30	Annual Expenditure Required
6. Recreation[f]	60	Annual Expenditure Required
7. Manpower corps[g]	160	For the Working Life of Trainees

Source: MacMillan and Lyon, p. xvii.

[a] Estimated from analysis of agricultural development programs by F. L. Tung, J. A. MacMillan, and C. F. Framingham. Drainage, land clearing, and farm management training, $8.4 million, generated 1.4 million man-years of employment.

[b] A $1.4 million in DREE industrial incentives for a rapeseed processing plant is estimated to generate forty-seven jobs and twenty trade center jobs. J. A. MacMillan and C. F. Framingham.

[c] The 1968 Interlake education expenditures of $7.4 million created 635 jobs, 536 man-years of employment in the school system, and ninety-nine trade center jobs.

[d] J. A. MacMillan and E. Nickel.

[e] P. G. Douglas and J. A. MacMillan.

[f] The job impact is calculated per $1 million of operating expenditures at Hecla Provincial Park, $700 thousand in 1976. The capital cost of $5 million is excluded. N. Brown and J. A. MacMillan.

[g] The $5 million Manpower Corps Expenditure 1967–76 increased wages from $82 to $219 per week and reduced the unemployment rate from 80% to 20% after training for 1,300 trainees resulting in an investment of 160 jobs. Marco Fernandez.

situation, the objective of research is to assist policy makers and administrators make more effective planning decisions. If analyses can be structured according to the six activities listed above, the needs of policy makers and administrators can be met as well as the requirements for testing rural development planning.

With respect to the first step—identification of quantitative objectives—one major policy goal of the British Columbia Ministry of Agriculture is to achieve greater self-sufficiency for major food commodities. The goal is consistent with the narrow development strategy of import substitution. A regional model can be used to illustrate the impacts on quantitative measures of rural development objectives including income, job creation, and income distribution of projects introduced to increase self-sufficiency. Currently an interregional, linear-programming model of agricultural sectors in British Columbia is being constructed.

Given that under the present system of production most ranchers are cow-calf producers, with calves being shipped to and finished in other provinces, planners are interested in the feasibility or impacts of backgrounding more calves (carrying calves over the winter to the feedlot yearling stage) and/or feedlot expansion in British Columbia. It is clear that an increase in cow-calf, backgrounding, or feedlot activities is consistent with the policy goal of import substitution, but may not be consistent with other objectives.

Ex ante rates of return can be calculated for the ARDA program expenditures—range improvement ($19.8 million) and forage production increases due to drainage and irrigation ($15 million) using a regional model. Given estimates of costs and increases in feeding capacities for spring, summer, fall, and winter feeding due to (*a*) range improvement, and (*b*) forage availability, estimates of the incremental income associated with any combination of the three production enterprises—cow-calf, backgrounding, and feedlot—can be calculated. Furthermore, it is necessary to illustrate the sensitivity of net income impacts (Y_{ij}) to alternative basic assumptions (table 2). The impacts will vary if prices represent a peak, trough, or average over product and input price cycles. Given the estimates symbolized in table 2, planners can review the initial allocation of development funds with respect to range versus forage improvement projects and alternative beef production activities or some combination of alternatives.

Table 2. Impact Measures (Income to Livestock Producers, Regional Incomes, Employment and Income Distribution) of Six Alternatives

	Range Improvement Projects	Irrigation and Drainage Projects
Cow/Calf	Y_{11}	Y_{12}
Backgrounding	Y_{21}	Y_{22}
Feedlot	Y_{31}	Y_{32}

The ARDA Subsidiary Agreement (Department of Regional Economic Expansion) was initiated in July 1977, and a review is scheduled for July 1979. Given time constraints, a preliminary analysis can provide a ranking of the six development alternatives or combinations outlined in table 2 based only on one impact measure, the net income to livestock producers generated per $1 million development expenditure. The discussion has been simplified by referring only to net income for the beef sector. If multiple objectives of income growth, employment growth, and income distribution are accepted for seven sectors (dairy, poultry, beef, grains, forage, fruits, and vegetables) in nine rural regions, an objective function of 189 components results. Special studies are needed, such as the community pasture evaluation by Barichello, to provide a detailed analysis of the economic efficiency and income distribution impacts of all individual projects. Current research on rural development planning in British Columbia can be grouped into three activities: (*a*) identification of quantitative rural development objectives, (*b*) construction of a sectoral interregional model for agriculture, and (*c*) *ex ante* feasibility studies; research on three other activities, (*d*) definition of a plan made up of development projects, (*e*) *ex post* evaluation, and (*f*) conclusions with respect to the plan and objectives are required to test rural development planning in British Columbia.

Observations on Rural Development Planning

A checklist of six research activities was outlined above to assist in designing and testing of rural development plans. This list requires refinement, but the general nature of the tasks is not likely to be disputed by many agricultural economists. We do not know of rural development plans in Canada other than the Manitoba case in which all six steps have been completed. The problem is that policy makers and administrators are not convinced of the relevance of a major commitment of economic research in Canadian rural development planning. A substantial increase in the documentation with respect to project and plan evaluations is required to increase the confidence of policy makers, administrators, and rural people in rural development planning models and research procedures. The cost of such documentation for British Columbia is not large relative to the total budget of $60 million.

A commitment to testing rural development planning in British Columbia requires improved communication between agricultural economists and plan administrators to overcome the following problems: (*a*) the desire by administrators to maintain flexibility by avoiding specificity and quantitative objectives, (*b*) the consistent underestimation of the time required to develop models and complete *ex ante* research, (*c*) the underestimation of the time required to implement programs and projects, (*d*) the conflict between adequate planning and the desire to commit project funds, (*e*) the difficulty of translating complex research into information useful to plan administrators, (*f*) the tendency of economists to make hasty generalizations about the means of improving rural development planning based on incomplete analyses of questionable data. Finally, if agreement by agricultural economists and planners with respect to the appropriate research procedures cannot be achieved, then rural development planning in Canada will continue as a nonscientific activity.

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Rural Industrialization and the Changing Distribution of Family Incomes

Brady J. Deaton and Maurice R. Landes

Income distribution has been a central topic in political economy and has received continuing emphasis by our profession. Few studies, however, have been undertaken to examine the distribution effects of rural industrialization. Notable exceptions are two recent studies which call attention to the effects of industry on the lowest income groups (Reinschmidt and Jones, Kuehn et al.). With poverty diminution remaining an important matter of public policy, the changing size distribution of family income among new industrial workers must be a central concern for rural development policy. The size distribution of income is important in shaping the social structure of society, in reducing transfer payments, in lowering development costs, and in facilitating recovery of investment in human capital.

Research Approach

The hypothesis explored in this paper is that the distributive consequences of rural industrialization are shaped by community and industry characteristics and the demographic traits of employees and their families (Gotsch).[1] An ordinary least squares regression analysis (OLS) was used to determine the association between selected measures of these variables and dollar changes in total family income (*FINCH*). All dollar figures were adjusted to 1977 price levels.

Three time periods were important considerations in the analysis: the year before the worker was first employed in the sample firm (t_1), the first year of work in the firm (t_2), and the most recent year, 1977 (t_3). A family member entering the work force may experience an abrupt shift in income between t_1 and t_2 particularly if he/she were unemployed or significantly underemployed in t_1. Thereafter, wage income will be determined by labor mobility in the firm over time. The dependent variable (*FINCH*) was specified as family income in t_3 minus family income in t_1. Variables were included to adjust for the different factors influencing family income changes between t_1 and t_2 and between t_2 and t_3. Data for the analysis were obtained from secondary sources and by questionnaires from 714 workers. These represented a 20% sample of the labor force in thirty-five plants randomly selected from a list of all firms (160) which located in rural Tennessee between 1970 and 1973 inclusively and had twenty or more employees.[2]

Variable Specification

The components of family income include both worker's and spouse's wages, transfer payments, and other income sources such as second jobs and asset earnings. Months worked in plant (*MWRK*) was entered as a variable to control for length of employment (t_2 to t_3). The effects of changes in labor force participation among family members were measured by introducing a discrete variable (0,1) to represent spouse taking a job (*SPENT*) or leaving a job (*SPEX*). Entry and exit were hypothesized, respectively, to be significant determinants of positive and negative family income changes. The gain (*GOTH*) or loss (*LOTH*) of other income, and of public

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[1] This hypothesis follows the reasoning of Gotsch in his study of the impact of tubewells on rural farming communities in Pakistan.

[2] These encompassed twelve different standard industrial classifications and were located in twenty-four different rural (non-SMSA) counties ranging in population from 7,800 to 78,800 in 1974. The average size of the sample firms was 105 employees.

assistance were treated similarly [gain (*GPA*), loss (*LPA*)].

Discrete variables were also entered to evaluate distributive effects by residence status and family well-being. Commuters (*COMM*), migrants (*MIG*), and return migrants (*RMIG*) were coded 1 to test differences as compared to local residents. Changes in the well-being of families were analyzed by classifying the sample into quintiles. Family incomes in t_1 were adjusted for family size by dividing the actual income by a factor of 1 plus .3 for each additional family member.[3] The sample was broken into quintiles Q_1 to Q_5 representing successively higher levels of well-being.

Individual Characteristics

Age (*AGE*), years of formal education (*EDUC*), and sex of the worker (*SEX*) were hypothesized in previous research to influence changes in family incomes (Smith and Morgan) and were included in this analysis. Younger workers are more competitive and flexible and, thereby, able to take advantage of changing labor market conditions. Hence, a negative relationship was expected. Level of formal education should be positively associated with the dependent variable as it reflects the relative store of human capital, basic skills, and socialization (coping skills) acquired in the education process. Females (0,1) are expected to contribute relatively more to family income changes because they are more likely to be the spouse entering the labor force. However, salary changes between t_2 and t_3 may be less for females, partially offsetting the t_1 to t_2 shift.

Previous work experience (*PREMP*) may have alternative effects in a measure of association with family income change. Since *PREMP* was specified as 1 if wage income was above zero in t_1, the higher income associated with t_1 employment may result in a lower income shift between t_1 and t_2. Consequently, a negative relationship could be expected. However, wage increases between t_2 and t_3 should be positively affected by previous work experience which complements the effects of education. Changes in the number of children (*FAMCH*) was included following the hypothesis of Smith and Morgan that larger families provide incentive for workers to seek out higher paying jobs.

Rural Labor Market Conditions

Bryant's conceptualization of rural labor markets provided useful guidelines for selecting appropriate measures of supply and demand conditions. Three aspects of a plant's demand for labor were hypothesized to be important determinants of family income changes. First, higher wage plants create a larger shift from previous wages, t_1 to t_2, and provide a greater scope for upward wage mobility, t_2 to t_3. This variable was specified as the ratio of average plant weekly wage to the average weekly manufacturing wage in the county (*RELWG*). The average plant weekly wage was measured by the average weekly wages of workers in the sample on a plant by plant basis. A positive relationship was expected.

Second, the relative skill requirements of the plant should have a similar influence on the dependent variable. Skill levels reflect the plant technology and labor demand more accurately than the relative wage, since the latter is more sensitive to local labor market conditions. Measures of wage and skill levels will be less correlated in rural labor markets with severe underemployment because high skills may be obtained at relatively lower wages. A weighted index of the percentage of production workers in skilled, semiskilled, and unskilled categories was used to measure the skill level of each firm.[4] A third measure selected was the size of the plant relative to the local labor force (*SIZRLF*) which provides a measure of labor demand relative to labor supply. Greater shifts in labor demand are expected to increase pressure for the plant to offer higher wages to attract an adequate number of workers with an appropriate range of skills.

Community factors expected to influence the distribution effects of new industry were community labor supply and the level of manufacturing development. The level of manufacturing development (*RLDEV*) depends on both the number and diversity of jobs in the labor market. More developed areas provide greater opportunity for upward adjustments in wages because of interfirm competition for workers. The measure of development used was the level of manufacturing employment weighted by the degree of industrial diversification (Isard, p. 270).[5]

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[3] The weight of .3 is analogous to that used to compute poverty level income by family size.

[4] The skill index was based on the proportion of the plants' workers who required three or more years of training (skilled), one or two years (semiskilled), and less than a year (unskilled). The percentages in each group were weighted by +1, 0, −1, respectively. Subsequently, +1 was added to each score for ease of interpretation in the regression analysis. This measure theoretically could range from 0 (100% unskilled) to 2 (100% skilled). The actual range turned out to be from 0 to 1.28.

Rates of unemployment were selected as measures of labor supply conditions. The unemployment rate at the time the worker was employed (*UNEMP*) may affect entry level wages, with greater unemployment rates associated with relatively lower wages. Also, the change in unemployment between t_2 and t_3 (*UNEMPCH*) may affect wage adjustments in the plant over the same time period. A declining unemployment rate will reflect tighter labor market conditions and relatively greater increases in wages. *UNEMPCH* was specified as the change in the unemployment rate ($t_2 - t_3$) as a ratio of the t_1 unemployment rate. Hence, a declining unemployment rate results in a positive sign and a positive association with the dependent variable.

Results of Analysis

The variables in the general regression were grouped to illustrate the relative contribution of each class to the total R^2 of .55 (table 1). The cumulative R^2 reflects the proportion of total explained sums of squares contributed by successive groups of variables. Most of the explained variation (52%) is associated with the group of income determinants representing structural shifts in family earnings: spouse entry (*SPENT*) and exit (*SPEX*) from the labor force, the gain (*GPA*) or loss (*LPA*) of public assistance, and changes in other income earnings (*GOTH*, *LOTH*). Demographic

Table 1. Regression Results: Variables Hypothesized to Explain Changes in Family Income (Thousands of Dollars) Associated with New Manufacturing Jobs in Rural Tennessee Counties

Variable	Mean	Standard Deviation	*b* Value	Standard Error	Cumulative R^2
INTERCEPT	—	—	.677	1.339	
SPENT (0,1)	.106	.309	4.083[b]	.460	
SPEX (0,1)	.112	.315	−6.050[b]	.454	
LOTH (0,1)	.018	.132	−4.140[b]	1.118	
GOTH (0,1)	.137	.344	1.735[b]	.421	
LPA (0,1)	.167	.373	−.681[a]	.377	
GPA (0,1)	.039	.194	1.644[b]	.751	.292
PREMP (0,1)	.832	.375	−3.598[b]	.418	
MWRK (months)	34.713	25.806	.014[b]	.007	
AGE (years)	32.475	10.280	−.044[b]	.017	
SEX (0,1)	.518	.500	.675[b]	.325	
EDUC (years)	10.971	2.407	.156[b]	.064	
FAMCH (#)	.219	.649	−.148	.237	.410
COMM (0,1)	.177	.382	.332	.386	
MIG (0,1)	.151	.358	.394	.408	
RMIG (0,1)	.167	.373	−1.029[b]	.392	.422
Q_1 (0,1)	.199	.399	1.695[b]	.454	
Q_2 (0,1)	.195	.397	.493	.441	
Q_4 (0,1)	.204	.403	−.792[a]	.427	
Q_5 (0,1)	.204	.403	−2.669[b]	.434	.494
RELWG (%)	.978	.225	3.246[b]	.847	
SKIL (Index)	.206	.243	−.734	.712	
SIZRLF (%)	.263	.235	2.663[b]	.700	.529
UNEMP (%)	6.976	3.111	−.057	.054	
UNEMPCH (%)	−23.093	53.403	.006[a]	.003	
RLDEV (Index)	2940.254	2267.404	.287[a]	.069	.547

$R^2 = .547$ $F = 24.7$ $n = 538$ Mean of *FINCH* = 2.334

[a] Significant at the .10 level of *t*.
[b] Significant at the .05 level of *t*.

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[5] The coefficient of specialization compares a county's sectoral manufacturing employment structure to the average structure for all rural Tennessee counties. The greater the measure the relatively more specialized and the lower the measure the relatively more diverse the employment structure. *RLDEV* is computed as (1 minus coefficient of specialization) × (manufacturing employment) because we expect that both the magnitude of employment and greater diversification contribute to industrial development. 1970 census data were used to compute the variable.

characteristics, principally *PREMP*, explained an additional 22%, resident status 2%, the quintile ranking of preemployment well-being 13%, plant characteristics 6%, and community characteristics 3%.[6]

The quintile measures reflect an equalizing effect in family incomes associated with industrial employment. The lower quintiles were positively associated with changes in family income, whereas the top quintiles had negative signs. The significant coefficients were Q_1, Q_4, and Q_5.

This indirect measure of increasing equality of family incomes was verified by computing relative mean incomes (*RMI*) by quintile for the preemployment period and for the current period. The *RMI* is the mean of the quintile expressed as a percentage of the mean of the total distribution of incomes and serves as an index of equality. The *RMI* measures indicated movement in each quintile toward the mean of the total sample. The quintile comparison reflects a shift toward greater equality of family incomes among employees in this sample.

The relative wages (*RELWG*) and size of the plant (*SIZRLF*) were positive and statistically significant along with the measure of relative manufacturing development (*RLDEV*). The measure of skills demanded by the plant (*SKIL*) was insignificant and negative, the opposite of the hypothesized relationship. The *SKIL* relationship may be partially explained by intercorrelation. The measures of plant characteristics were the most intercorrelated of all variables in the model: *RELWG* and *SKIL* at .55, and *RELWG* and *SIZRLF* at .35. The wage and skill measures may be further complicated by the extent of training offered by the firm and corresponding wage adjustments made to cover training costs. The skill measure was highly correlated with months of training ($r = .8$).

The unemployment rates were consistent with our hypothesis. The entry level rate (*UNEMP*) had a negative sign but was not significant. The percentage of change in the unemployment rate t_2 to t_3 was significant.

Changing Labor Force Participation and Family Well-Being

The regression analysis revealed the net importance of females and of spouse labor force entry and exit. Since, the sex composition of the sample is 50–50, the sex of the spouse may alter interpretation of the sex coefficient as it affects family well-being. Therefore, an attempt was made to clarify the relationship among alternative patterns of labor force participation by sex and their consequences for family well-being.

Wage changes for male and female workers for each time period were examined by quintile. In each quintile, female workers earned a larger increment in the t_1 to t_2 shift, but a lower increment in the t_2 to t_3 period compared to males. The total wage change t_1 to t_3 was greater for females. Thus, family incomes were influenced principally by the abrupt change associated with female workers taking jobs in new industry. Further analysis revealed that a combination of factors, including the type of plant and community, lower education levels, and older ages impede t_2 to t_3 wage increases for females.

The general conclusion of greater income equality based on the regression and relative mean income analysis does not necessarily reflect a decline in the incidence of poverty. The consequences of industrial jobs for rural poverty diminution is a critical policy concern and can be addressed by a more detailed examination of the data. To accomplish this objective the proportion of families in poverty in each time period was compared for nine permutations of labor force participation (table 2).[7] Of 538 families analyzed, 10 (2%) began in poverty t_1 and ended in poverty in t_3. Fifty-four families escaped poverty status, but four families dropped from above to below poverty for a net decline of fifty families. Therefore, the number of families below poverty declined from 64 (12%) to 14 (3%) between t_1 and t_3. Four hundred and seventy families were above poverty in both time periods.

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[6] The plant and community variables were entered in sequence after other family measures were in the model. As each set was entered the sequential sums of squares (*ss*) were compared with the partial *ss* to evaluate whether inferences changed and to determine serious problems of interaction. This process revealed no changed inferences.

Discrete variables in a regression framework usually introduce heteroscedasticity and reduce the efficiency of the model. Residual plots against dependent and independent variables revealed evidence of possible heteroscedasticity which may result in inefficient, but unbiased estimators.

[7] Poverty level incomes for 1977 price levels based on Bureau of the Census figures were $3,025 for a nonfarm individual, plus a factor of .32 for each additional family member.

Table 2. Changes in Poverty Status Associated With Labor Force Participation by Household Members (Column Percentage in Parentheses)

Labor Force Participant	Poverty Status				
	P_1P_3	P_1NP_3	NP_1P_3	NP_1NP_3	Total
M_1M_3	4	14	1	98	117
	(40)	(26)	(25)	(21)	(22)
F_1F_3	3	19	0	41	63
	(30)	(35)	(0)	(9)	(12)
B_1B_3	1	0	1	172	174
	(10)	(0)	(25)	(37)	(32)
M_1F_3	1	2	0	6	9
	(10)	(4)	(0)	(1)	(2)
M_1B_3	0	12	0	82	94
	(0)	(22)	(0)	(17)	(17)
F_1M_3	0	2	0	3	5
	(0)	(4)	(0)	(1)	(1)
F_1B_3	0	5	0	22	27
	(0)	(9)	(0)	(5)	(5)
B_1M_3	1	0	1	18	20
	(10)	(0)	(25)	(4)	(4)
B_1F_3	0	0	1	28	29
	(0)	(0)	(25)	(6)	(5)
Total	10	54	4	470	538
% of Total	(2)	(10)	(1)	(87)	(100)

Note: $t_1 = 1$, $t_3 = 3$; P is below poverty level income; NP is above poverty level income; M is male only working; F is female only working; and B is both spouses working.

Of the fifty-four families that escaped poverty between t_1 and t_3, 38 (70%) were aided by the labor force participation of female family members in t_3 (F_1F_3, M_1F_3, M_1B_3, F_1B_3). The largest group (35%) was F_1F_3. Families with only one spouse working in t_1, but both working in t_3 made up 31% of those escaping poverty in t_3 ($M_1B_3 + F_1B_3$). Of the 470 families not in poverty in either period, 263 (56%) had working females in both periods (F_1F_3, B_1B_3, F_1B_3, B_1F_3).

Conclusions and Implications

Analyzing family income rather than simply wage earnings is necessary to gain an understanding of the effects of industrialization on family well-being. This analysis has focused only on families of workers in new manufacturing plants and does not represent income distribution for the community. At the same time, the results presented suggest that inferences based on Lorenz curves or measures of relative mean incomes of quintiles may be misleading if income is not adjusted for family size and if the changing incidence of poverty is not evaluated. Whether a poverty threshold is a reasonable measure of well-being is a question which remains unaddressed in this paper, but deserves attention.

The broad conceptual model employed in this research helps evaluate the relative importance of plant and community characteristics for family income changes. Further refinement of these measures of the local labor market combined with a proper conceptual model of household behavior may begin to clarify policy deliberations concerning income distribution. Until this is achieved, the puzzlements of Rivlin (among others) over the constancy of the size distribution of income will remain unanswered.

This attempt to partition the size distribution question into a manageable research segment revealed that new manufacturing jobs resulted in a shift toward equality of family incomes among manufacturing workers in rural Tennessee, but only 12% of the families sampled were in poverty in t_1. Obviously, industrialization is not a panacea for solving poverty problems as both history and other research reveals (Summers et al.). Consequently, analysis of sectoral interactions at the local level and associated household labor force participation will be required to provide more insight into appropriate policies for modifying income distribution.

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The Incremental Nature of Public Service Delivery: Implications for Rural Areas

Lonnie L. Jones and Steve H. Murdock

Provision of public services involves a number of complex economic, social, and political factors that have long been of interest to social scientists (Rogers and Whiting). These have become areas of renewed interest due to repercussions from the recent "tax revolt" and public referenda related to tax and service limitations. For rural areas, the implications of these events for public service delivery are difficult to discern because of such inherent characteristics as low population density, low levels of need awareness, and ineffective community leadership.

In general, economists have viewed the delivery of public services as a resource-using activity aimed at enhancing public welfare and have used analytical models for public service delivery similar to those used in private sector analyses. Although this perspective has been useful in some respects, as Barkley points out, economists have limited success in explaining patterns of public service delivery. This lack of success, he maintains, is due in part to a rather poor definition of the concept of public good, but even more so to the fact that the financial and other arrangements involved are the result of the interaction of a complex set of factors, many of which are not included in standard economic analyses.

Public services are provided largely outside private market mechanisms. Rather than being determined by price, their levels are a function of a complex interaction of the interests of numerous groups of individuals, associations, elected officials, and public agencies. Prices are not determined by the market; consumers rarely pay according to their level of consumption; and prices often do not allow for recovery of fixed costs and may not even cover variable costs. Services may be purposely made available at less than direct user cost to encourage consumption and thereby promote such goods as increased educational attainment and the maintenance of physical health in the general population. The standard models for public service delivery clearly need supplementation.

A Model of Public Service Decision Making

This paper suggests a decision model that views public service provision as taking place in a system (Buckley) composed of three major subsystems, each of which possesses a unique set of rewards and which together interact to determine the decisions surrounding public services. These components are (*a*) consumers—those who pay for the services, (*b*) elected officials—those who allocate public revenues, and (*c*) public agencies and bureaucracies—those that deliver public services and receive public revenues. Our intent in this paper is to draw together several divergent bodies of literature bearing on public decision making and to suggest implications for service delivery in rural areas.

To predict the net effects that result for the public service system as a whole, the composition of each subgroup, its relevant rewards, the mechanisms available for maximizing rewards, and the ways in which subgroups interact must be delineated.

Service Consumers and Special Interest Groups

This model views individuals as concerned with their self-interest in public services consumption. It recognizes that single individuals can do little to directly influence the outcomes of service delivery. Decisions as to what, how, when, and where services will be produced are collective. It is often taken for granted in public services research that communities, large

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or small, have common interests and can be expected to further those common interests as a group (Hildreth and Schaller). On the contrary, Olsen's reasoning demonstrates that such "community interest" exists rarely and is generally inconsequential as a source of influence. Collective decisions follow not from the expression of some common goal of the community but rather from the expression of numerous goals of small, special interest groups (p. 126).

It is a combination of the desire of individuals to maximize benefits from public services relative to costs and their inability individually to have a significant effect on the outcome of collective decisions that provides the incentive for formation of groups with mutual interest. The central goal of such special interest groups is to influence the public to provide a bundle of services from which the individuals within the interest group receive benefits in excess of costs.[1] This outcome is possible because public service benefits may be specific to the group, while costs (taxes) to support production are distributed over all taxpayers. Individuals, other interest groups, or the community at large cannot be expected to counterbalance the influence of small, active special interest groups (Olsen).

Elected Officials

In the capacity of legal decision maker on the size and distribution of the community budget, the elected official is positioned between the public service consumer and the supplier. He is a broker of services in the decision process. The elected official cannot retain profits from his actions. Nevertheless, he may be expected to attempt to maximize those benefits that he can appropriate from the system—the political support of his constituency and the prestige and community influence associated with public office.

Since the elected official attempts to maximize political support in the process of providing services and extracting taxes, he must view his constituency in two ways—as service consumers and as taxpayers. He may perceive that he is awarded greater political support from service consumers for additional services. On the other hand, he perceives that his political support is a decreasing function of the level of tax payments that must be made to pay for the services. Hence, he must strive for some optimum position of service delivery and taxation which will maximize his political support within these constraints, or at least ensure sufficient support to remain in office.

Astute politicians (those likely to retain office over time) will recognize that their constituency is not a homogeneous group with respect to the benefits received, taxes paid, or willingness to yield political support for all public programs. That citizens respond politically to differences in benefits and costs is an important consideration of the politician. Rather than attempt to assess the demand for all services and all citizens, it is likely that the politician willingly will enter into coalitions with special interest groups, offering delivery of public services from which the groups benefit most in exchange for their political support. The creation of such coalitions both reduces the complexity of the politician's task in assessing demand for services and increases his chances of continuation in office.

There is also a strong incentive for the elected official to form coalitions with bureaucrats because his ability to deliver public services depends upon the willingness of the bureaucratic managers of these agencies to respond to requests for additional services. The quid-pro-quo of this coalition is the offer by the politician to support the budget submissions from the agency in exchange for a satisfactory supply of public services requested. The benefit to the politician in the exchange is the creation of an image of political effectiveness in the eyes of the interest group demanding the services.

Elected officials bear political, rather than financial, risks for their expenditure decisions. If power over resource allocation and service distribution is valued for its potential to command votes, then the community supply curve of political support is not the simple summation of individual supply curves. The politician must account for power differentials within the community and actively pursue stable coalitions to ensure continued support. This may lead to a conflict between the will to economize on public expenditures, on the one hand, and the need for political support on the other. Implied is the trade-off between political survival and government efficiency.

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[1] The activities used to do this include (*a*) organizational activities, including formation of a formal group structure, (*b*) public relations activities including propaganda favoring the position of the group, (*c*) lobbying activities, (*d*) challenge of officials who do not support group positions, (*e*) formation of coalitions with those public agencies that provide a particular service of benefit to the interest group, and (*f*) formation of coalitions with private firms who produce the factor inputs required in the production of the service.

Public Agencies and Bureaucracies

Public service agencies are linked closely to the two groups discussed above. These agencies are created by public officials to serve the needs of service-user groups and are ultimately dependent on the public and its elected officials. This dependence, however, is less pervasive than sometimes thought because the agency evolves an existence and a set of rewards quite separate from the entities that created it. This is often referred to as bureaucratization, a process that is well documented in social science literature. It consists of the progressive independence of the agency from its originator and the establishment of a set of internal goals and rewards for its members (Blau 1956, Weber, Selznick). As an agency approaches bureaucratic maturity, overall maintenance of the agency and one's role within the agency becomes a primary goal, in substitution for the public goals that brought it into existence (Stockfisch). Thus, to the extent that the goals and rewards for the agency depart from those of its originating group, the bureaucracy performs in a manner quite different from that intended (Selznick).

For a public service agency and its personnel, the standard goals of a business organization are not relevant. The public agency does not earn a profit, and its employees do not necessarily receive higher salaries based on efficiency (Niskanen). In fact, salary differentials are often slight and other rewards may become as important as monetary gains. Such alternative rewards as security, public prestige, and power within the public service system as well as increased salaries tend to increase as one's relative position within the agency increases and as agency size and power increase.[2]

The mechanisms involved in maintaining the relevant rewards of increased security, public prestige, and power consist of factors aimed at agency control. Foremost among these control mechanisms are (*a*) increased consolidation of expertise within the agency, (*b*) control of information by the agency, and (*c*) the ability of the agency to make its maintenance valuable to closely associated outside groups (Weber, Stockfisch).

The first two of these mechanisms are engendered by the processes which create most agencies. This creation results from the fact that community needs arise that are met neither by private firms nor by citizen volunteers. Professionals are developed to deal with the need. Consolidation of these professionals within an agency or bureaucracy leads to increasing monopoly of information concerning the need area. As this process continues, the dependency of the public on the agency for expertise and information increases as does the agency's ability to control circumstances surrounding the need area (Selznick).

The agency's control of its own destiny is also increased by its ability to make its continued growth and maintenance valuable to a variety of outside groups. Although the most obvious of these groups are the service users specified by the mandate that created it, the agency uses several means to extend its influence beyond its target group (van Es). Among the ways of increasing interest in its maintenance is the creation of numerous citizen participation groups whose expressed purpose is to guide the agency but who in fact tend to be co-opted by the prestige and, in some cases, by monetary rewards. As van Es notes, "Citizen participation . . . is usually sponsored by the bureaucratic organization. The bureaucracy tends to initiate the process, define its purpose, and set its boundaries" (p. 86).

In sum, then, the public agency as a bureaucracy tends to develop goals and rewards that may differ from its intended purpose. Pursuit of these rewards leads to increased agency size and resource needs and to the use of various mechanisms for controlling the system and thereby ensuring the continuation of the relevant rewards. Public service agencies are, therefore, active participants, not merely reactants, in the decision process. As such, they are a public corollary to Galbraith's conception of the corporate technocrat (p. 129).

Group Interaction and System Effects

While these three groups of the total public service delivery system pursue sets of internal goals, their interaction determines the overall level and distribution of public services at a given place and point in time. The process entailed in this determination is best described as one of incrementalistic exchange (Blau 1964, Homans). That is, in order for the participants in each group to achieve their respective goals, it is essential that each exchange something with the other and this has normally resulted in progressive increments of rewards within the system.

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[2] The major criteria for success of bureaucratic management reflect this reward system. They include (*a*) range of responsibility, (*b*) budget size, and (*c*) increases in these over time. These and related factors constitute the bureaucrat's preference function which he attempts to maximize.

The elements of the exchange consist of public interest groups trading political support with elected officials for increased services, the elected official exchanging funding and other support with the bureaucracy for the provision of services to his supporting interest groups, and the bureaucracy exchanging the range, types, and extent of the services to interest groups and elected officials in exchange for increased budgets, agency responsibilities, and the prestige and power these entail for agency personnel. In such a system each group's relevant rewards are achieved.

The historical pattern of incrementalism is a function of the need for system stability. That is, the subsystems need to continually reinforce their interdependencies (Homans). New interest groups arise which demand increased services from their elected officials in exchange for continued or increased political support. Such services are provided as elected officials allocate increases to agency budgets. In addition, even when service demands are not increasing, the maintenance of "good will" within the system often requires at least marginal increases in agency budgets. The result of these processes perpetuated over time is an ever expanding number and range of services and increasing public service budgets.[3]

Implications for Public Service Delivery

The current crisis in public services resulting from the "tax revolt" and public referenda on tax and service limitations can be explained by several aspects of the proposed model. One possible explanation is that through time the public service system has become unacceptably inefficient to warrant continued support by interest groups or the general public. That is, overall cost of public services and the costs for the individual as a member of the general public have exceeded the benefits that he obtains as a member of an interest group or groups. That this may have occurred in some cases is suggested by the fact that a large percentage of public employees voted for Proposition 13. Perhaps they perceived its overall general benefits to exceed those presently received by them as public employees. The likelihood of such inefficiency occurring is suggested by Stockfisch and can be seen as a result of the incremental process delineated above and the growth of interest groups within a period of rapid inflation.

Alternatively, one might suggest that the interest group rising in support of the tax revolt—the middle class taxpayer—is one which historically has been poorly organized, whose needs and members are difficult to identify, and as such has been difficult for the system to co-opt. In this case, the concern may be less with inefficiency of government than with the distribution of public service benefits and its income equity implications. The emergence of a well-organized, middle-income taxpayer interest group may be expected to provide impetus to alter the distribution of benefits and costs, but it will not necessarily result in a more efficient public service delivery system.

Each of these alternatives appears plausible, and, in any given locale, either or both may explain much of the discontent with the public service system.[4] In either case, the decision model developed in this paper suggests a pervasive ability of the public service system to move from current disequilibrium and reestablish itself by realignments of public agencies, politicians, and special interest groups. Unless the relevant rewards of the system are altered, the structure of new alliances will reflect the relative strengths and incentives of each group's members. Reduced costs of public services or more equitable distribution of benefits may be expected to occur only by coincidence and not by design.

Consequences for Rural Areas

These predictions suggest that the present crisis may have especially deleterious effects on service provision in rural areas. The present system with its wide range of federally mandated public services recently has begun to implement service delivery in rural areas. Many of these services have been provided as spillovers from programs initiated for urban constituencies and bureaucratically expanded to rural areas by the incremental process. This has resulted in subsidies for some services such as medical, education, highway construction, and utilities (Jones and Gessaman, Day, Muehlbeier). The new tax and service limitation proposals tend to stress the localization of service costs. If enacted widely, these would tend to affect rural areas disproportionately by reducing support for available services.

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[3] Bureaucracies have been found to continue growth even in the face of a declining constituency. Rather than indicating agency ineptness or inefficiency, such growth results from the pursuit of a set of rewards relevant to the agency. That the total public service system remains unimproved simply reflects the separate nature of subsystem and total system goals and rewards.

[4] California's Proposition 13 appears to be a revolt against high costs of public services in general. In Texas, a special legislative session on taxation is dealing chiefly with issues of redistribution of the tax burden rather than tax reduction overall.

Even if service costs are not localized, public service support problems for rural areas are implied in a realignment of the system that is dictated by the interaction of public agencies, elected officials, and interest groups. As implied earlier, creation of interest groups is an essential first step in public service provision. Their creation and effectiveness are largely functions of service need awareness, effective leadership, and cohesive memberships. Rural areas historically have had low levels of service need awareness (Murdock and Schriner, Jones and Morgan), less able leadership (Simon and Gagnon), and, of course, a small and scattered population. Even with patterns of renewed nonmetropolitan growth (Beale), it appears unlikely that these factors can be overcome readily. Just as these characteristics have tended to delay improvement of rural services in the past, they likely will result in slower development of rural interest groups compared to those in urban areas. Although rural-dominated legislatures in some states may help to alleviate these problems, it would appear that rural communities may experience interim losses in the range and quality of services unless they move more aggressively than in the past.

Conclusion

The model of public service delivery suggested here needs both further refinement and careful empirical analysis. It suggests that an understanding of public service delivery systems requires a perspective that combines basic premises of economics with those of sociology and political science and emphasizes microanalysis of group behavior within the larger public service system. It is also a relatively pessimistic model, suggesting that the overall public interest is usually sacrificed to the more immediate rewards to be gained within its various subsystems. So long as subsystem rewards remain unchanged, the system will reestablish itself even if temporarily altered by changes in the number and relative influence of specific groups.

The model also suggests that the system is alterable if society is willing to establish alternative reward structures within the participating groups. The introduction of competition through the creation of bureaucratic duopolies or oligopolies, greater reliance on private firms, marginal rather than average cost pricing of services, and the use of vouchers with which individuals may choose among service suppliers have been suggested (Stockfisch). Within the existing bureaucracies, the provision of greater salary differentials, more opportunities for merit-related benefits, and perhaps even bonuses for increased efficiency and cost cutting could be implemented. In addition, limited tenure for agency heads, "sunset laws," and more carefully clarified criteria for career progress might alter the process of bureaucratization and differentiation.

If the proposed model is in fact correct, alterations are implied for the way in which we analyze public service delivery systems for purposes of policy recommendations. The analysis of alternative conceptual approaches and of the feasibility of alternative delivery systems are areas in which the need for research emphasis is clearly both immediate and essential.

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Discussion

Frank M. Goode

The initial impression is that the three papers in this session are quite dissimilar. That is, one deals with program planning, the second deals with conceptual issues exclusively, and the third paper is oriented much more empirically. However, at least implicitly all three papers point out the need for additional information if effective rural development programs and projects are to be forthcoming. My comments will focus on these information requirements.

Rural Development Planning

MacMillan and Graham argue that we need to standardize the procedure used in rural development planning; namely, we need to follow the six-step procedure outlined in their paper. Following this procedure would help accomplish three things: first of all, it would lead to a systematic plan for rural development projects; second, it would result in more effective evaluation of projects; and third, it would create observations by which one could analyze statistically the success and failure of rural development projects.

Regarding the first benefit claimed for the six-step plan, it represents nothing new to the agricultural economist and, as the authors acknowledge, few agricultural economists would disagree conceptually with them. In general, this is correct. However, I would suggest that step two of their plan is excessively restrictive. That is, not every rural development plan needs an input-output or regional linear-programming model as an effective tool for developing projects. In many instances, the sectorial models would have to be so detailed and so precise to be useful that the cost of constructing them would be simply prohibitive. In other instances, sectorial models would be of relatively little use in constructing rural development plans.

As to the second benefit for their six-step plan, it is unquestionably true that far too little attention is devoted to evaluating the impact of rural development programs. However, I will argue below that this may be more a result of a lack of information than any distaste for the project evaluation type of research.

The third benefit claimed for the six-step procedure is that it would make possible a more "Scientific" approach to studying the effects of rural development programs. The authors seem to suggest the analysis-of-variance approach that has been so popular among the plant and animal sciences in recent decades. The approach has worked well for the scientists in those areas, but I would suggest that it is not the proper approach for agricultural economists to take in dealing with issues concerning effective rural development programs. The major reason for this is that, unlike the scientists in the hard sciences, we are not in a good position to control important factors that may determine the success or failure of a given rural development program. A given rural development program may be successful in one setting and a dismal failure in another. At the present time we are in no position to specify, or even identify, the relevant variables that must be controlled when conducting this evaluative analysis.

Consider an example of rural areas which have a policy goal of attempting to improve the income levels of rural residents. A popular suggestion has been to improve the level of rural services, thereby making the community a more attractive location for industry or for workers in an industry. However, before one can formally test this as a rural development plan, several pieces of information are required. Namely, we must have fairly hard evidence that the level of services in a community does in fact help attract industry. Second, the planner must know what impact a new plant in a community will have on the income levels of the residents of that community. The other

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two papers in this session pretty well sum up the state-of-the-art as it relates to those two issues. The Jones-Murdock paper implies that the state-of-the-arts is in the conceptual stage and much work remains to be done before we can answer effectively the question of how service provision is generated in rural areas. The Deaton-Landes paper is a pioneering work in the second of these areas and is obviously not the definitive work. The point is that the information that would be necessary to implement the MacMillan-Graham plan is simply not available in many problem areas and is not likely to be available in the near future.

Thus, I would suggest that a much more productive line of inquiry would be to determine if the level of public services is related to industrial location. If the answer to that question is yes, then conceptual models such as that provided by Jones and Murdock must be implemented so that one can understand and intervene in the process of rural community service delivery.

Public Service Provision in Rural Areas

The Jones-Murdock paper provides a conceptual model that is potentially useful in analysis of the public service issues in rural communities. If in fact the provision of public services in rural areas directly contributes to the welfare of rural people, then it is imperative that a conceptual framework such as this be developed to guide our analysis of this problem. Many of our conceptual frameworks are outdated and are particularly narrow in focus in that they do not incorporate the potential contributions of other disciplines such as rural sociology and political science. The Jones-Murdock paper provides an example of how we might break out of this tradition.

One thing that might have made their conceptual model more effective would have been to call on a body of theory much more familiar to agricultural economists. For example, the theory of public expenditure, or what is currently referred to as public choice theory, might have been employed and might have led to a theory with similar conclusions. For example, there is a body of literature that argues that the democratic form of government to some extent can replace a market mechanism in determining the optimum and efficient level of public services. It seems to me that Jones and Murdock are arguing that this "quasi market" is beset by some market failure. Again, this is not really a substantive issue; it is much more an exposition issue.

I do not agree with the Jones-Murdock paper in their implications for rural areas. I would argue that the application of their model to certain areas of the country (specifically, selected regions in the northeastern United States) would indicate that the level of service provision in rural areas may increase rather significantly. That is, in this part of the country, and in other parts as well, there is a significant urban to rural migration. Many of the urban to rural migrants find a significantly lower level of services in rural communities. The effect of this is the formation of interest groups in the rural areas which desire additional services. Second, the urban to rural migration, by virtue of the one man-one vote rule, is placing relatively more voters in rural areas, and the astute politician will be sensitive to this demographic change and may in fact be more willing to respond to the rural interest groups than he has in the past. Thus, the basic forces identified in the Jones-Murdock model may very well exist in selected rural areas of the United States and many lead to an increasing level of services rather than decreases.

Income Distribution Impacts of Rural Industrialization

Those of us interested in the viability of rural areas must be particularly vigilant on two points. First of all, we must attempt to address the critical questions that must be answered if we are to provide the information necessary for effective rural development programs. Second, we must be certain that we operationalize the concepts and measure the variables in our studies with care. We must be particularly careful in selecting our research topics because we are faced with a very difficult and complex issue and relatively few resources are being devoted to understanding it. Third, we do not have the wealth of conceptual frameworks and empirical information that are available to many of our coworkers in other subareas of agricultural economics.

I think that Deaton and Landes have been successful in addressing an important question in our attempts to understand the complex issues associated with rural economic systems. However, I would hasten to add that they should move as soon as possible to a much more important question. That is, they have addressed the question of what are the income impacts for people employed in new rural plants. The next logical step seems to be to look at the question of what type of people benefit from new plants. One can get a distorted view of the positive effects of rural plants if he looks at only those who are able to find employment in these new plants. As a policy matter, the important issue is what types of people benefit when particular types of industry locate in rural areas.

It seems to me that, in general, Deaton and Landes did an admirable job formulating a statistical model for explaining income changes. However, there appears to be two major difficulties in the variables used to operationalize selected concepts and in their interpretation of the statistical analysis. For example, they argue that the expected sign on their dichotomous sex variable is positive (females = 1) because a female is more likely to be a new participant in the labor force. Next, they argue that the previous work experience of the individual may be important in explaining changes in income associated with employment in a new plant. Their theoretical arguments for these two variables are quite persuasive. However, when they attempt to operationalize the concept of previous employment history, they define, in essence, a variable that reflects whether or not the individual was a new entrant into the labor force.

Their model has no variable reflecting previous work experience; instead, it has a variable that in fact measures entrants into the labor force and a sex variable. The result is that their main argument for the expected sign on the sex variable is captured in another variable. Although this leads to some serious mistakes in interpreting their empirical results, those results may become even more interesting than their discussion implies. That is, the sex variable in their analysis is not positive because a female is a new entrant (the new entrant variable captures that effect) but it appears that the employment created in rural areas may in fact pay relatively high wages for female employees. That is, even after controlling for labor force entrance, the coefficient on the sex variable implies that females were (relative to men) underemployed before the new plants began operation.

A second problem in this paper involves the variable used to operationalize the concept of labor supply. Deaton and Landes use the county unemployment rate to operationalize the supply of labor. In general, this is not an effective measure for labor supply because the labor shed surrounding a given plant in many cases is smaller than the county. It is also common that there may be as much variation in unemployment rates between labor sheds within a county as there is variation in unemployment between counties. Because it is the unemployment rate in the given labor shed that is important, the county unemployment rate is not particularly useful. In addition, the measurement of county unemployment rates is notoriously poor in rural areas due to small samples. Thus, it is not at all surprising that the county unemployment rate was not a significant variable in their analysis.

A third point is that their dependent variable embodies two effects, namely, employment in a new firm and upward mobility after employment. Because the factors associated with these two effects are likely to be different, they should be analyzed separately. That is, one model should explain changes associated with employment in the new firm (change in family income between t_1 and t_2). A second could be used to explain upward mobility with change in income t_2 to t_3 as a dependent variable.

Conclusion

MacMillan and Graham lay out the useful steps in developing effective rural economic programs, but the implementation of those steps is many years down the road. Until we get additional conceptual work such as that provided by Jones and Murdock and until these conceptual models are empirically implemented, as was the case with Deaton and Landes, little can be done in the way of developing consistently effective rural development programs.

Assessing and Projecting the Effects of Agricultural Research Extension, and Technology
(W. B. Sundquist, University of Minnesota, Chairperson)

Returns to Agricultural Research and Extension Programs: An *Ex-Ante* Approach

A. A. Araji, R. J. Sim, and R. L. Gardner

Agricultural research in the United States has evolved into a decentralized federal/state system. The state agriculture experiment stations have responded with considerable flexibility to changing circumstances and have developed locally appropriate technologies (Peterson and Fitzharris 1975). The contribution of research to productivity growth in agriculture is well documented. Griliches showed a 700% annual rate of return to investment in hybrid corn research and a return of 360% in hybrid sorghum. Peterson (1967) reported that the annual rate of return to investment in poultry research was 140%. The internal rate of return to investment in cotton research in Brazil was reported to be 90% (Ayer and Schuh). Barletta estimated an internal rate of return to wheat research in Mexico of 75%. Akino and Hayami estimated a 75% rate of return to rice-breeding research in Japan. Internal rates of return to investment in experiment station research in the United States by commodity range from 36% for cash grains research to 46% for livestock research (Bredahl and Peterson). Aggregate evaluation of agricultural research and extension shows that the value of inputs saved in 1950 ($9.6 billion) far exceeded the cost of research and extension ($7 billion) for the entire 1910–50 period (Schultz). Peterson's 1971 analysis shows that the cost of research and extension for the 1910–67 period ($9.4 billion) is about one-third of the value of inputs saved in 1967 ($25.9 billion). In general, internal rates of return to investment in all agricultural research is estimated to range between 35% and 171% (Griliches).

Previous evaluation studies used an *ex-post* approach and are criticized on both methodological and empirical grounds. Implementation and maintenance costs of research are omitted and thus the resulting estimates of internal rates of return are biased upward. *Ex-post* evaluations estimate the benefits of past research and so have little impact on decisions relative to resource allocation between current and future projects. Previous evaluation studies have failed to estimate explicitly the impact of extension on the overall research effectiveness.

This paper, using an *ex-ante* approach, attempts to estimate the return to investment in current and future research and extension programs for several agricultural commodities and analyzes the impact of cooperative extension on research effectiveness.

Method and Procedure

Research and extension programs in sheep, fruits and vegetables, potatoes, cotton, and rice were evaluated in 1977 for the western region. The new knowledge generated by these programs is forthcoming for implementation. Personal interviews of agricultural researchers and extension specialists were conducted to determine the initiation and termination dates of research projects for each commodity, the probability of research success, the probability and rate of adoption of research results with and without extension, and research and extension resources required to implement and maintain the new technology. The expected changes in yield, quality, and

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cost of production ensuing from the implementation of the technology were estimated. In order to account for research and extension costs in supporting fields, all research and extension expenditures allocated to each commodity for the duration of the program were used to estimate the rate of return.

The Model

The basic analytical procedure developed by the Interim Research Evaluation Committee of ESCOP was used in the analysis of the data in this paper.[1] The flow of benefits from each research project was estimated by the following equation:

$$(1) \quad B_{jt} = A_{jt}[(\Delta P_{jt} V_t - V_o) - \Delta C_{jt}],$$

where B_{jt} is the benefits accruing to the jth technology in year t, A_{jt} is the expected total production affected by the jth technology in year t, ΔP_{jt} is the expected change in net productivity of the affected crop or livestock due to the jth new technology in period t, V_t is the expected price of each unit of output of the affected crop or livestock in year t, and $V_t = [V_o + V_o(f \Delta P_t)]$, where f is the flexibility ratio and V_o is price per unit in the base year, and ΔC_{jt} is the expected change in production cost of the affected crop or livestock due to the jth new technology in year t.

B_{jt} is the maximum benefit that could accrue to society as a result of implementing the research findings. However, the outcome B_{jt} is probabilistic in nature because it depends on the probability of research success, $P(S)$, and the probability of adoption, $P(A)$. Thus, the expected flow of benefits from research and extension is defined as

$$(2) \quad E(B_j) = \sum_{t=1}^{N} B_{jt}\, P\{A_t \cap S_t\},$$

where N is the number of years for which the research technology, j, affects production and/or cost.

The present value of the expected flow of benefits from the research and extension investment is obtained by "discounting" the right-hand side of equation (2).

$$(3) \quad E(B_j) = \frac{\sum_{t=1}^{N} B_{jt} \cdot P\{A_t \cap S_t\}}{(1 + r)^t},$$

where r is the social discount rate.

Similarly, the present value of the flow of research and extension costs may be expressed as

$$(4) \quad C_j = \sum_{t=1}^{N} (M_{jt} + I_{jt} + E_{jt} + R_{jt})/(1 + r)^t,$$

where C_j is the present value of the total costs associated with investment in, and implementation of, the jth technology, M_{jt} is the cost of maintenance research required to sustain output at previously achieved levels for technology j, I_{jt} is implementation cost incurred by the farmer in adopting the jth technology, E_{jt} is extension cost involved in transferring the jth technology to the farmer, and R_{jt} is the annual expenditure for research investment for the jth new technology for the affected crop or livestock in year t.

The 1976 production year was used as the base to calculate changes in productivity and cost due to research and extension. The 1973–76 average prices were used and production costs for each commodity were obtained from other studies. Expenditures in each research problem area prior to 1978 were compounded at 6% to bring costs to the 1978 level. All measures of benefit were calculated with and without extension to estimate the contribution of cooperative extension to research effectiveness. For all commodities considered, extension expenditures varied from 3.9% to 24% of research costs in the western region. Maintenance costs were estimated by researchers and extension specialists to range between 10% to 35% of research costs. In this paper, extension and maintenance costs were estimated at 20% and 30%, respectively, of research costs. Payoff periods of thirteen and eighteen years, based on scientists' judgments and the nature of the technology being developed, were used to estimate returns to investment in research and extension by commodity groups.

Measures of Benefit

Several measures of benefit are calculated in this paper. The benefit-cost ratio B/C is defined as the ratio of the present value of the expected flow of benefits from the implementation of research results to the present value of the flow of expenditures. This benefit-cost ratio is expressed as

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[1] The authors acknowledge the contributions of B. R. Edelman and Jerome Siebert to the development of the basic method used in this paper.

$$B/C = E(B_j)/C_j. \tag{5}$$

The internal rate of return (*IRR*) is defined as the rate of return that equates the present value of the expected flow of expenditures in the development, implementation, and maintenance of technology, and the present value of the expected flow of benefits. The internal rate of return is calculated by an iterative process using the following equation:

$$E(B_j) - C_j/(1 + IRR)^t = 0, \tag{6}$$

where *IRR* is internal rate of return. The net present worth (*NPW*) is defined as the present value of the expected flow of benefits $E(B_j)$ minus the present value of the flow of expenditures (C_j). *AEV* is the annual equivalent value of the flow of benefit. These measures of benefit were calculated for each research problem area and aggregated by commodity, using a social discount rate of 10%.

Analysis of Results

The *ex-ante* estimates of return to investment in experiment station and extension programs for nine agricultural commodities in the western region are summarized in table 1. The results show that for a flow of benefit of thirteen years the internal rates of return are 33.28% for sheep, 35.83% for lettuce, 45.63% for tomatoes, 39.85% for grapes, 47.73% for apples, 0% for citrus, 104.43% for potatoes, 42.38% for cotton, and 33.83% for rice. The internal rates of return for a flow of benefit of eighteen years are 34.75% for sheep, 38.28% for lettuce, 47.58% for tomatoes, 41.70% for grapes, 48.69% for apples, 25.17% for citrus, 104.81% for potatoes, 42.38% for cotton, and 35.59% for rice. The payoff for research and extension programs varies by the research problem area, the type of the commodity, and the absolute value of the output.

Analysis of the results indicates that significant returns to investment in experiment station research will not be realized without extension involvement in the dissemination and implementation of research results (table 2). Depending on the commodity and the estimated flow of benefits, approximately 25%–66% of the expected flow of benefits from ex-

Table 1. *Ex-ante* Return to Public Investment in Agricultural Research and Extension in the Western Region by Commodity

	Sheep	Lettuce	Tomato	Grape	Apple	Citrus Fruits	Potato	Cotton	Rice
1990[a]									
with extension[c]									
B/C ratio	4.63	6.03	13.44	7.18	9.99	0.54	36.35	9.26	4.85
NPW ($ mill.)	92.973	32.567	113.178	56.622	325.303	−17.038	1012.400	170.910	37.934
AEV ($ mill.)	13.088	4.585	15.933	7.971	45.796	−2.501	148.584	21.845	5.340
IRR (%)	33.28	35.83	45.63	39.85	47.73	0	104.43	42.38	33.83
1995[b]									
with extension[c]									
B/C ratio	6.29	9.74	21.05	10.97	13.99	3.53	55.09	13.24	6.69
NPW ($ mill.)	135.732	57.615	188.860	94.512	473.189	99.117	1591.956	266.148	58.14
AEV ($ mill.)	16.550	7.025	23.028	11.524	57.696	12.356	198.460	30.773	7.089
IRR (%)	34.75	38.28	47.58	41.70	48.69	25.17	104.81	43.67	35.59
1990[a]									
without extension[d]									
B/C ratio	2.66	3.63	4.32	2.18	4.90	0.14	13.93	1.78	1.15
NPW ($ mill.)	35.300	14.183	25.182	9.003	117.460	−26.381	308.718	13.481	1.200
AEV ($ mill.)	4.970	1.997	3.545	1.267	16.536	−3.872	45.309	1.723	0.169
IRR (%)	24.03	24.98	29.97	19.15	33.23	0	69.36	17.85	11.44
1995[b]									
without extension[d]									
B/C ratio	3.61	6.82	6.33	3.49	7.11	1.53	22.04	2.74	3.48
NPW ($ mill.)	55.707	31.990	41.803	19.653	185.475	17.391	515.911	31.489	21.087
AEV ($ mill.)	6.792	3.901	5.097	2.396	22.615	2.168	64.316	3.641	2.571
IRR (%)	26.11	29.47	32.38	22.98	35.12	15.02	70.63	21.59	21.26

[a] The flow of benefits is assumed to continue to 1990.

[b] The flow of benefits is assumed to continue to 1995.

[c] With extension at 20% of research costs plus maintenance of 30% of research costs throughout the period for which there is a flow of benefits.

[d] Without extension but with maintenance costs of 30% of research costs throughout the period for which there is a flow of benefits.

Table 2. Estimated Decrease in Internal Rates of Return to Investment in Experiment Station Research without Extension Participation by Commodity

	Flow of Benefit	
Commodity	13 Years	18 Years
	%	
Sheep	28	25
Lettuce	30	23
Tomato	34	22
Grapes	52	45
Apple	30	28
Citrus	—	40
Potato	33	33
Cotton	58	51
Rice	66	40

periment station research will not be realized without coordinating extension participation.

Nonquantifiable Benefits

In addition to benefits such as increased yields, reduced costs, and improved quality of agricultural products, research priorities in the state experiment stations are directed toward the achievement of national objectives in the areas of energy and natural resource conservation, improved environmental quality, and the development of basic scientific knowledge. Analysis of the results indicate that the implementation of the forthcoming research results will lead to more efficient use of pesticides, fertilizer, fuel, and water. The development of basic knowledge through research on crops and livestock has direct application to research on humans. For example, studies of hormones in sheep are relevant to the diagnosis of hormonal diseases in humans. Genetics research on sheep is directly applicable to the problems of arthritis and bone cancer brought about by genetic deficiencies. Basic research on plant viruses and tissue culture will provide fundamental knowledge for use by researchers in the medical profession.

The Impact of Maintenance Effort in Research and Extension

The results of the survey of researchers and extension specialists indicated that, depending on the commodity, between 10% and 35% of their scientific time is devoted to maintaining present productivity with current technological knowledge. The results indicate that the elimination of maintenance efforts will cause a reduction of 5%–40% in productivity (table 3). Flexibility ratios, calculated from the demand elasticities developed by George and King, were used to estimate the price and level of consumer expenditure that would result from a reduction in the quantity of each commodity. With the exception of apples and sheep, consumer expenditures on agricultural commodities will rise in the absence of maintenance research and extension.

Table 3. Estimated Effect of Eliminating Maintenance Effort in Research and Extension on Productivity, Prices, and Consumer Expenditures by Commodity

Commodity	Percentage of Time Spent on Maintenance	No. of Years without Maintenance	Percentage Change in Quantity	Percentage Change in Price	Change in Consumer Expenditures ($1,000)
Apples	10	5	−25	9	−4,909
		10	−35	10	−2,476
		15	−40	12	−2,476
Citrus	25	5	0	0	0
		10	−10	22	26,890
		15	−30	66	44,364
Lettuce	30	5	−5	52	25,054
		10	−10	105	47,177
		15	−15	157	66,301
Potatoes	35	5	−5	33	217,593
		10	−10	67	409,946
		15	−15	100	573,031
Sheep	30	5	−10	6	−7,748
		10	−25	15	−23,154
		15	−25	15	−23,154
Tomatoes	30	5	−5	28	67,761
		10	−10	57	126,768
		15	−15	85	177,191

Summary and Implications

The expected returns to investment in current research and extension programs for nine agricultural commodities in the western region were analyzed. The results show that the internal rates of return to public investment in combined research and extension programs in production agriculture range from 33% for sheep and rice to 104% for potatoes. Cooperative extension augments the effectiveness of experiment station-problem identification, reduces the time lag between the development of new technology and its implementation, and increases the adoption rate of research results. Depending on the commodity and nature of the research program, 25% to 60% of the expected returns to public investment in agricultural research will not be realized without extension involvement.

The effectiveness of experiment station research, and thus returns to public investment, are significantly influenced by the time and rate of adoption of research results by the agricultural industry. The rates of adoption and the time required to implement research results vary by commodity and the nature of the technology; they are significantly influenced by the market structure and the socioeconomic environment in which the decision maker operates. In general, a higher adoption rate of research results is expected for large farm operators and for agricultural commodities supported by well established farm organizations.

The results of research and extension program evaluations in the western region also show that the state agricultural experiment stations and the cooperative extension service system are highly responsive to the implementation of national policy. Research and extension priorities in agriculture are directed toward the achievement of national objectives in the areas of energy, water, and national resource conservation and the enhancement of environmental quality. The results show that current research findings contribute to the prevailing body of scientific knowledge and provide the foundations for future studies.

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Assessing Returns to Agricultural Extension

Wallace E. Huffman

In a technically and economically dynamic environment, extension has the potential for enhancing the efficiency of production. Although extension was formalized and given federal financial support by the passage of the Smith-Lever Act in 1914, the literature reporting on reasonably rigorous attempts at *ex post* evaluations of agricultural extension has begun to emerge only recently. In earlier studies (e.g., Griliches and Evenson 1968), expenditures on research and extension were aggregated, and the total was used as one of the variables for explaining the growth in agricultural output (or productivity).

The objective of this paper is to present an assessment of the returns to investments in agricultural extension.[1] This assessment is based primarily on a survey of published research that has investigated the separate contribution of agricultural extension to agricultural production and to resource allocation. The main conclusion is that the returns to extension, at least in the United States, are modest or better.

The paper is organized as follows. The first section reviews some economic models that incorporate extension as an explicit variable and discusses the direction of potential biases in previous estimates of returns to extension. The final section presents conclusions.

An Assessment

Two different approaches to evaluation—*ex post* and *ex ante*—seem potentially useful in assessing the performance of public-sector extension. Policy makers are aided by good *ex ante* evaluations. They need to know the expected effects of alternative resource allocation policies. Good *ex ante* evaluation is, however, difficult because it requires predicting future advances in technology and future problems arising from often unforeseen weather, agricultural pest, and market conditions. These predictions are subject to large errors which reduce considerably the potential value of *ex ante* evaluations.

Researchers have developed some widely accepted rigorous methods for *ex post* evaluations. Most economic analyses involve developing and fitting models to historical data.[2] In these analyses, there is an attempt to find and statistically test for meaningful relationships between inputs of extension resources and some type of end results; e.g., output, profit, income, etc. The federal extension service has taken an alternative and more sociological approach to *ex post* evaluation (U.S. Department of Agriculture 1977). Greater emphasis is placed on intermediate ends, e.g., number of activities and of people involved, opinions about activities, knowledge, attitudes, skills, aspirations, and practices changed. This emphasis on intermediate ends, which are of limited value themselves, has the potential for diverting attention and research from the fundamental question of returns to investments in extension. In this paper, an assessment of returns to extension is limited to *ex post* evaluations of the contribution of public-sector agricultural-extension input to agricultural production.

Economic Models

In a technically and economically dynamic environment, agricultural extension has the potential for enhancing technical and allocative efficiency of agricultural production. Both public and private institutions are engaged in supplying information to farmers. In public sector extension, agricultural extension personnel assemble, organize, and interpret mar-

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Some parts of this paper draw from Huffman 1978.

[1] By agricultural extension, I mean the activities of extension directed to the dissemination of information on crops, livestock, and planning and managing farm businesses. This definition excludes extension activities directed to the dissemination of information on a wide range of other important topics.

[2] Some economic studies perform "cost-benefit" calculations that are of a nonstatistical nature.

ket information and simplify technical information for dissemination to farmers. They also demonstrate new techniques and consult directly with farmers on specific production and management problems. The contribution of extension to enhancing the efficiency of agricultural production depends crucially on the dynamic nature of agriculture, which in turn depends on the output of basic and applied agricultural research, the quality (and quantity) of extension personnel, the education level of farmers, and the knowledge gap between applied researchers and farmers. Agricultural extension activities might be viewed as attempting to close this knowledge gap.

Representatives of private firms engage in activities similar to those of public-sector extension. One might hope that publicly supported agricultural extension provides information that is objective and oriented closely to aiding farmers meet their objectives, rather than to meeting the objectives of private nonfarm firms.

Public-sector extension information has the potential for enhancing the efficiency of agricultural production. Consider the effect of extension on the efficiency of a competitive farm firm that produces two or more final products, uses two or more variable inputs, and one or more fixed inputs. There are two dimensions of efficiency—technical and allocative. Extension increases technical efficiency if, for a given bundle of inputs, added extension information increases one or more final products, leaving the other final products unchanged. Thus, technical efficiency is measured against an output standard. Extension increases allocative efficiency if, for a given level of technical efficiency, added extension information increases firm profit, other things equal. In a dynamic environment, this increased profit might arise from correcting a failure of one or more of the following conditions for profit maximization: (*a*) marginal rate of product transformation equals the ratio of relative output prices, (*b*) marginal rate of substitution between pairs of variable inputs equals the ratio of relative input prices, and (*c*) value of the marginal product of each input is equal across separable production activities and equal to the marginal factor price for variable inputs.

Attempts to assess the marginal products of (or returns to) agricultural extension have concentrated almost exclusively on some form of production function estimation. Exceptions, however, are the attempts to incorporate the effect of extension into an adjustment function of a dynamic model (Huffman 1972, 1974, 1977).

Production Functions

Agriculture is a multiproduct industry, and farms are multiproduct firms. Let $\mathbf{Y}$ be a vector of $m \geq 2$ final products, $\mathbf{X}$ a vector of n variable inputs ($n \geq 2$), $\mathbf{Z}^\circ$ a vector of fixed inputs or endowments, and $\mathbf{E}$ a vector of environmental variables, including extension. Most studies attempt to explain the total value of farm output from aggregate or microdata; i.e., $Y^* = \sum_1^m P_i Y_i$, where P_i is the price received by the firm for Y_i. By estimating an empirical specification, $Y^* = \sum_1^m P_i Y_i = F(\mathbf{X}; \mathbf{Z}^\circ, \mathbf{E})$, one can test the hypothesis that extension contributes to the efficiency of agricultural production. In this multiproduct framework, the marginal product of extension is, however, a partial measure of a combination of technical and allocative efficiency effects.[3]

Most empirical studies have chosen a functional specification between the total value of farm output and extension of the following type:

$$(1) \quad \ln Y^* = A + B \ln \mathbf{X} + C \ln \mathbf{Z}^\circ + g\, Ext,$$

where A, B, C, and g are unknown parameters, and *Ext* is a measure of agricultural extension. This functional specification implies that the marginal production of extension is proportional to the total value of farm output, the marginal product is increasing as extension increases, and the marginal product increases as the size of farm output increases.

Adjustment Functions

An alternative model and one more suited to exploring the effects of extension on allocative efficiency is a dynamic model in which extension affects the rate of adjustment to disequilibria. Consider the three equations relating to the n factor demand functions for $\mathbf{X}$ of a competitive firm:

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[3] In a gross output formulation, allocative effects are captured only through the effects that E has on the choice of the output mix (and perhaps on the prices received for final products). A value-added or profit definition of "output" provides a potentially better specification for capturing a wider range of efficiency effects.

$$(2)\quad X^*_{it} = D_i\ (\mathbf{P}^*_t,\ \mathbf{Z}^\circ,\ \mathbf{E}),\ i = 1, \ldots, n,$$

$$(3)\quad X_{it} - X_{it-1} = \beta_i\ (X^*_{it} - X_{it-1}),\ 0 \le \beta_i \le 1, \text{ and}$$

$$(4)\qquad \beta_i = \beta_i(\mathbf{E}).$$

The demand function for input X_i in time period t (X^*_{it}) is a function of a vector of anticipated farm input and output prices ($\mathbf{P}^*_t$), a vector in inputs fixed to the firm ($\mathbf{Z}^\circ$), and a vector of environmental variables ($\mathbf{E}$), including extension. The adjustment or reaction equation (3) specifies that the change in usage of the ith variable input between time period t and $t-1$ is proportional to the gap between the demanded quantity $\mathbf{X}^*_{it}$ and the actual quantity in period $t-1$. The adjustment coefficient β_i summarizes the rate that farmers adjust actual input usage to the optimal usage. The novelty of the model is that the adjustment coefficient is specified as a vector of environmental variables, E, including extension. The variable adjustment specification of the dynamic model permits a test of the hypothesis that agricultural extension enhances adjustment to changes in economic incentives, which is one aspect of allocative efficiency.[4] Closing the disequilibrium gap increases farm profit.

Empirical Analyses

The size of constant dollar U.S. expenditures on public sector extension has a persistent upward trend of about 4% per annum over the period 1930 to 1975 (table 1). Although extension expenditures cover nonagricultural production areas—4-H activities, home economics, etc., it is useful to compare the relative distribution of expenditures on extension with the distribution of farms by agricultural production region. This comparison is instructive even though the total share of the extension budget allocated to agricultural extension changes over time, if the share of total expenditures on agricultural extension activities remains similar over the regions. This comparison assumes, however, that average constant dollar expenditures per farm is a meaningful measure of the cross-sectional intensity of agricultural extension. With this measure, the Northeast, Mountain, and Pacific regions have had persistently above-average extension intensity, and the Lake states, Northern Plains, and all regions of the South (for 1930 and 1955) have had below-average intensities. Furthermore, the changing distribution of farms is slow to be reflected in the distribution of extension expenditures. For example, between 1930 (1955) and 1975, the Corn Belt, Lake states, and Northern Plains have shown a 17.7 (15.2) percentage point gain in the share of all farms in the United States, but these states show as a group, a −1.4 (0.5) percentage point fall (gain) in the share of expenditures on extension.

Cline provides estimates of agricultural production-oriented extension expenditures for production regions. These data have been deflated by the number of farms in the region to obtain a second measure of the changing intensity of agricultural extension. These data show dramatic increases in the intensity of extension, which are the result of steadily increasing real expenditures and a large decline over the period in farm numbers. The Northeast, Southeast, and Delta states regions have shown the most dramatic rise in intensity of extension, and the Lake states, Corn Belt, and Northern Plains regions have shown the smallest increase.

The quality of extension information and the demand for information by farmers seems likely to be related to the output of agricultural research. Column (5) of table 1 provides data on the ratio of state agricultural experiment station expenditures to expenditures on public sector production-oriented agricultural extension. These data show, for all regions, an increase from 1930 to 1975 in the research-to-extension intensity. Except for the Appalachian and Southern Plains regions, which are relatively extension intensive, and Pacific region, which is relative research intensive, the other seven regions have similar agricultural research-to-extension intensities.

Studies by Griliches, Evenson (1968), and Cline report *ex post* estimates for the United States of rates of return to combined investments in agricultural research and extension. In the 1970s, several studies have reported *ex post* analyses of the separate contribution of agricultural extension to agricultural production and resource allocation. These studies, although they are not limited to the United States, are summarized in table 2. Four of the studies are for the United States, two are for India, and one each is for Brazil, Kenya, and the Philippines. All studies present estimates of returns to extension derived from an estimated agricultural production function, except for Huffman 1974 and 1977, which report re-

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[4] This model also is applicable to the empirical analysis of adoption of new inputs or technology.

Table 1. Distribution of Expenditures on Public-Sector Extension by Agricultural Production Region: 1930–1955–1975

Region— Fiscal year	Total expen. on extension, constant 1967 dollars ($1000)	Percentage of U.S. total		Estimated prod.-oriented extens. per farm (const. 1967 $ per farm)	Ratio of State Agr. Exp. Sta. expenditures to est'd prod.-oriented extension expenditures
		Extension expenditures	No. of farms		
United States					
(48 states)	(1)	(2)	(3)	(4)	(5)
1930	48,195	100.0	100.0	4.3	1.18
1955	121,273	100.0	100.0	9.3	2.45
1975	276,431	100.0	100.0	62.5	2.75
Northeast					
1930	9,347	19.4	8.5	9.9	1.38
1955	18,057	14.9	7.9	17.6	2.72
1975	38,069	13.8	6.3	136.5	2.57
Lake states					
1930	3,596	7.5	8.5	3.8	1.45
1955	10,337	8.5	9.6	8.3	2.78
1975	23,419	8.5	12.3	43.2	2.95
Corn Belt					
1930	8,349	17.3	17.3	4.3	1.16
1955	17,501	14.4	18.8	7.2	2.28
1975	39,862	14.4	25.9	34.7	2.40
Northern Plains					
1930	3,349	6.9	7.3	4.1	1.11
1955	8,372	6.9	7.2	8.9	2.39
1975	20,484	7.4	12.6	36.9	2.83
Appalachian					
1930	5,859	12.2	16.3	3.2	0.79
1955	18,200	15.0	18.2	7.7	1.45
1975	40,769	14.7	12.6	73.1	1.96
Southeast					
1930	4,725	9.8	11.6	3.7	0.89
1955	12,081	10.0	11.0	8.5	2.54
1975	31,538	11.4	6.1	116.4	2.87
Delta states					
1930	3,414	7.1	11.4	2.7	0.76
1955	9,608	7.9	9.9	7.5	1.99
1975	20,171	7.3	4.5	101.4	2.67
Southern Plains					
1930	3,528	7.3	11.1	2.9	1.01
1955	9,177	7.6	8.6	8.2	2.10
1975	20,621	7.4	9.1	51.1	2.26
Mountain					
1930	3,219	6.7	3.8	7.5	1.54
1955	7,539	6.2	3.8	15.4	2.87
1975	20,231	7.3	5.3	85.9	2.84
Pacific					
1930	2,811	5.8	4.2	6.1	1.94
1955	10,401	8.6	5.1	15.8	4.11
1975	21,268	7.7	5.3	91.5	5.21

Sources: Cline for 1930 and 1955 and unpublished federal extension table; USDA (1976) for 1975.

turns to extension derived from an estimated adjustment model.

In assessing the returns to extension, four major potential sources of bias must be considered. First, all effects of extension cannot be captured in one empirical model. One reason is that our methods for estimating one type of effect of extension on efficiency often preclude the estimation of other effects. For example, when the marginal product of extension is obtained from an estimated production function, the returns to extension from its effect on factor choice are missed because the inputs are included in the estimated equation as independent variables. Thus, a single comprehensive estimate of the marginal product of extension is generally impossible, and adding up separate effects creates potential problems with omissions and double counting. To the extent that some of the positive effects of ag-

Table 2. Summary of Returns to Extension

Study	Country (Data Set Year)	Type of Study	Conclusion
1. Patrick and Kehrberg (1973)	Brazil–Eastern (1968)	Production function	Extension, number of direct contacts of farmers with extension agents during the study year, had positive but generally not statistically significant effects on value added in farm production.
2. Evenson and Jha (1973)	India (1953–54 to 1970–71)	Productivity change	Extension, index of maturity of extension program, contributes significantly to agricultural productivity change only through interaction with research programs. Investment in extension programs yields a 15%–20% social rate of return.
3. Huffman (1974)	United States-Corn Belt (1959–64)	Allocative efficiency-production	Extension (days, average for 1958 and 1960, allocated to crops by agents doing primarily agricultural work) and education are substitutes in inducing optimal nitrogen fertilizer usage on hybrid corn. The marginal value of extension time on this one decision is estimated at $4.48 per hour of extension agent time allocated to crops or a social rate of return of 1.3%. Total social return from enhanced decision-making suggested to be in excess of 16%.
4. Mohan and Evenson (1975)	India (1959–60 to 1970–71)	Productivity change	The Intensive Agricultural Districts Program (presence vs. absence) contributed to more rapid agricultural productivity change. The social rate of return realized on the investment was 15%–20%.
5. Huffman (1976a)	United States, Iowa, North Carolina, Oklahoma (1964)	Production function	Extension, agent days allocated three years earlier to crops and livestock activities by agents doing primarily agricultural work, contributes significantly to level of agricultural production. The marginal product of extension is $1,000–3,000 per day.
6. Mooch (1976, 1978)	Kenya-Vihiga, (a western division) (1971)	Production function	An index of crop related extension contact with male and female farm operators during the last year contributes significantly to corn (maize) yields. Extension and education are substitutes in corn production; extension interacts positively with the rate of nitrogen fertilizer application on male operated farms (1978).
7. Huffman (1976b)	United States, Iowa, North Carolina, Oklahoma (1964)	Production function	Same as for Huffman (1976a) except marginal product of extension $1,000–2,500 per day.
8. Halim (1977)	Philippines-Laguna Province (1963–68–73)	Production function	An index of extension contact with farms, derived by weighting frequency of contact over previous five years, contributes positively and significantly to agricultural production. Marginal products imply a "relatively high return of extension contact."
9. Huffman (1977)	United States-Corn Belt (1959–64)	Allocative efficiency	Same as Huffman (1974) except marginal value of extension time on this one decision is estimated at $600 per day of extension agent time allocated to crops or a social rate of return of 110%.
10. Evenson (1978)	United States (1949–71)	Productivity change	Extension, expenditures on applied farm management research and on applied agricultural engineering research are combined with expenditures on extension activity and deflated by number of commodity-subregions, interacts negatively with education and positively with applied research. The internal rate of return on extension expenditures is 110%.
11. Huffman (1978)	United States, Iowa, North Carolina, Oklahoma (1964)	Production function	Extension is measured as days allocated to crops, livestock, and planning and managing farm businesses and as days allocated to the separate components. Emphasis is placed on holding factors constant that may be correlated with the extension variables. Marginal product of extension is sensitive to output mix (livestock vs. crop), ranging from very large to negative values. Crop extension performs better than other components.

ricultural extension are omitted, the returns to extension will be biased downward. None of the studies in table 2 report comprehensive estimates of the different effects of agricultural extension.

Second, extension contact with farmers probably creates a form of capital that affects the efficiency of production for more than one period. Although information supplied by extension workers and demanded by the farmers is time and subject specific, the useful information content seems likely to last longer than one year. Thus, it is not the extension contact during one year that affects the efficiency of production, but it is the accumulated net investment in extension information or the stock of useful information. Let the gross input of extension in year t be E^*_t, let benefits start immediately, and let the annual depreciation rate because of changing technology and changing market and environmental conditions be δ. The relevant stock of extension is $Ext_t = \sum_{i=0}^{\infty} (1 - \delta)^{t-1}E^*_{t-i}$; i.e., a weighted summation of current and past contact between farmers and county extension agents. To illustrate the nature of the bias, assume that E^*_t is equal for all t (i.e., $E^*_t = E^*$ then $Ext_t = E^* \sum_{i=0}^{\infty} (1 - \delta)^{t-i} = E^*/[1 - (1 - \delta)] = E^*/\delta$. If extension is measured empirically as $E^* (= \delta Ext_t)$, rather than as Ext_t, then the least squares estimate of the coefficient of E^* in a linear regression equation like equation (1) is, in general, a biased upward estimate of the "true" coefficient of Ext_t. The magnitude of the bias is $1/\delta$. For example, if the annual depreciation rate on extension contact is 50%, $\delta = 0.5$, the bias is 2; i.e., the estimated coefficient and marginal product of E^* is twice as large as the "true" coefficient and marginal product of Ext_t.

From a benefit-cost perspective, the bias is not this serious. When extension creates a capital input, the contribution of extension contact in any one year to output is distributed over several years. Assuming a 50% depreciation rate and a 15% (5) discount rate, one dollar of benefits appropriately distributed over current and future years has a present discounted value of $0.89 ($0.96). Thus, if one compares benefit-cost ratios, treating extension as a current input rather than a capital input causes an upward bias of roughly 5%–10%.Because of the different empirical measures of extension for the studies summarized in table 2, care is required in drawing implications from the findings.

The third major potential source of bias arises from the interaction of research and extension in agricultural production. The development of agricultural technology and quality of extension information seems likely to depend on agricultural research. We expect research and extension to interact positively in contributing to agricultural production, and failure to account for this interaction creates a specification error in a regression equation. The result is biased estimates of the coefficients of the included variables. I expected the bias of the coefficient of extension to be positive. Evenson and Jha and Evenson (1978) are the only studies to consider explicitly the research extension interaction.

The final major source of bias arises from the fact that private-sector information may be correlated with public-sector agricultural extension, but private-sector information is excluded from the empirical analyses because data are not available. If the information capital created from private-sector information and from public-sector extension has a positive effect on the efficiency of agricultural production, then the estimated coefficient of the public-sector extension variable will be biased upward by the exclusion of the private-sector information variable. All the returns summarized in table 2 seem likely to be biased upward by the omission from the empirical analyses of private-sector information.

When these potential sources of bias are taken into consideration,[5] the rate of return to agricultural extension seems to be modest or better in the United States, modest in India, and difficult to assess in the other studies.

Conclusions

Although recent studies have added significantly to our understanding about the contribution of agricultural extension to agricultural production and decision making, further research is needed to guide public and private decision making. Some important research areas are: (*a*) Determine the type of interaction between education levels of farmers, agricultural extension, and agricultural research. To what extent are they complements to or substitutes for one another? (*b*) Determine the extent of differential effects of extension information on farms of different size. (*c*) Determine the relative magnitude of the technical and allocative effects of agricultural extension and determine how these effects depend on the output mix of farms and the quality of agricultural research. (*d*) Reinvestigate the contribution of extension to agricultural production by using more recent data, especially for the United States. This would permit us to check for significant changes in the marginal product of extension overtime. (*e*) Determine the extent to which private information sources substitute for or complement extension information.

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[5] Market prices might not reflect the marginal social value of agricultural output. The rest of the economy might not readily absorb resources released from agriculture.

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Projecting Agricultural Productivity and Its Economic Impact

Yao-chi Lu, Leroy Quance, and Chun-lan Liu

Public investment in U.S. agricultural research and extension (R&E) programs, mostly by the USDA and state agriculture experiment stations, increased rapidly in recent decades. Expenditures oriented to increasing agricultural production increased from $149 million in 1939 to $377 million in 1972 (1958 dollars). But with such visible signs as Proposition 13 in California to zero-based budgeting at the national level, both public and private decision makers are demanding greater accountability for, and productivity from, burdensome tax dollars.

Many studies indicate that the rate of return to agricultural R&E in the United States has been high, in the range of 24% to 31%, according to our previous estimates (Lu and Cline). However, very little research has gone beyond *ex post* evaluation of past R&E. Since higher returns to R&E are realized through increased productivity, it is also important to establish the quantitative relationship between R&E and productivity growth. From this relationship we can project the *ex ante* rate of return to R&E and also determine the R&E needed to sustain agricultural productivity growth to meet future demands for food and fiber at home and abroad.

We first examine the relationship between R&E and agricultural productivity growth and formulate a productivity simulation model including R&E as a principal decision variable. Under alternative R&E growth rate scenarios, we use the simulation model to project agricultural productivity growth. We then evaluate the impacts of R&E-derived productivity growth on social benefits and estimate benefit/cost ratios and the *ex ante* rate of return to R&E investments.

Agricultural Productivity Simulation Model

Many factors contribute to productivity growth, but because it is impossible and impractical to include all factors influencing productivity growth, we include in the model only the most important, observable, and measurable variables. We hypothesize that productivity change depends on technological change, the rate of diffusion of new technology, weather, relative factor and product prices, and farm programs. The rate of technological change in turn depends on public and private research expenditures, while the rate of diffusion depends on extension expenditures and the educational attainment of farmers.

Although important, farm programs and relative prices are excluded from this study. So far we have not been able to separate the price effect from the effect of technological change. Past attempts to measure the effect of farm programs on agricultural productivity have not been successful primarily because of measurement and data problems. Due to data limitations, private research expenditures were also excluded in this study. Thus, our study attributes changes in agricultural productivity to lagged values of production oriented R&E, changes in farmers' education, and weather.

Based on the above observation, the productivity change model is specified as

$$P_t = \prod_{i=0}^{n} R_{t-i}^{a_i} E_t^{b} e^{cW_t},$$

where P is aggregate productivity index for U.S. agriculture in year t, R is lagged production-oriented R&E expenditures directed at increasing agricultural production, E is index of educational attainment of farmers in the current period, W is U.S. weather index in the current period, i is lagged year for R&E expenditures, n is number of years for which R&E expenditures are lagged, and a_i, b and c are coefficients.

To estimate equation (1), time-series data

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from 1939 to 1972 were assembled. Production indexes are obtained from the 1964 and 1973 issues of *Changes in Farm Production and Efficiency*. Production-oriented R&E expenditures are from Cline (1975). Education indexes are constructed from a series reported by Evenson, and weather indexes are constructed from Stallings, and Kost. A detailed explanation of all data series can be found in Cline (1975).

The Almon distributed lag method and Durbin's two-stage procedure were used to estimate the parameters of equation (1). The results are as follows:

$$\begin{aligned}\hat{P}_t = {} & R_t^{.0009}\, R_{t-1}^{.0017}\, R_{t-2}^{.0024}\, R_{t-3}^{.0029}\, R_{t-4}^{.0033} \\ & R_{t-5}^{.0036}\, R_{t-6}^{.0037}\, R_{t-7}^{.0037}\, R_{t-8}^{.0036} \\ & R_{t-9}^{.0033}\, R_{t-10}^{.0029}\, R_{t-11}^{.0024}\, R_{t-12}^{.0017} \\ & R_{t-13}^{.0009}\, E_t^{.7851}\, e^{.0020\, w_t}.\end{aligned}$$

According to these estimates, a 1% increase in R&E will increase productivity gradually, reach its peak impact six to seven years later by increasing agricultural productivity in each of those years by .0037%, and continue impacting productivity for the following six years when the annual impacts become negligible. We also estimate that a 1% change in the weather index will change agricultural productivity 0.2% in the same direction, and a 1% increase in the education index will increase productivity 0.78% (Lu and Cline).

Alternative Futures for Agricultural Productivity Growth

Public decisions made now and in the near future about research and extension programs will affect productivity growth for many years. Thus, we need to make assumptions concerning possible scenarios for such decisions so that we can simulate productivity growth and analyze results in terms of benefits, costs, and rates of return.

To project alternative paths for agriculture productivity growth under different sets of assumptions about the R&E rate, the educational level attained by farmers, and weather conditions, we consider three scenarios. Under the first scenario, R&E is maintained at a zero growth rate. Since this scenario assumes a low level of R&E to create new technology, it is called the low technology scenario.

Under the second scenario, we assume that real R&E growth during the 1939–72 period continues into the future; i.e., real R&E grows 3% per year. Since this scenario uses the average historical R&E growth rate, we call it the baseline scenario.

The third scenario assumes a 7% R&E growth rate to accelerate research and development of new technologies and to increase extension activities for disseminating new technologies. With increased emphasis on R&E, it is likely that more new technologies will become available for adoption under this scenario. Thus, we call this the high technology scenario and assume that unprecedented technologies, if any, will be produced and adopted, and their potential impacts on productivity are evaluated and incorporated into the productivity projections under this scenario.

For all scenarios, farmers' educational attainment is assumed to increase along an S-shaped growth curve fitted to the education index data from 1939 to 1972 with the equivalent of four years' college training being an upper limit.

Decision makers cannot exercise control over weather, thus it is included in the model as a stochastic variable. Based on the frequency distribution of the weather index 1900–72, a normal distribution was selected to approximate the distribution of the weather variable. The parameters of the normal distribution were obtained from the estimated weather index as follows: mean = 100.7 and the standard deviation = 11.4. These parameters are incorporated in the simulation model, and future weather indexes are generated for all scenarios.

The projected education index and the three alternative R&E growth rates were used to prime the simulation model to project future agricultural productivity. However, to keep random weather from masking the impact of R&E-induced technological change on productivity growth, 200 weather indexes were generated from the normal distribution for each year to simulate normalized weather conditions. The mean, standard deviation, and range of the productivity index were computed, but only the mean values of the productivity indexes are reported.

Columns 1 and 2 of table 1 show the mean values of the projected productivity indexes under the low-technology and baseline scenarios, respectively. For comparison, actual average productivity index in the base years (1974–76) is presented in row 1. The

Table 1. Projections of U.S. Agricultural Productivity, 1985–2000 (1967 = 100)

	Projected Productivity Indexes			Expected Increases in Productivity Due to Impacts of			
Year	Low Technology	Baseline	High Technology	Photosynthesis	Bioregulators	Twinning	Maximum Productivity Projections
Base Years (1974–76)	112.0	112.0	112.0	0.0	0.0	0.0	112.0
1985	125.0	125.3	126.4	0.0	0.1	0.0	129.2
1990	131.0	132.1	134.8	0.0	0.6	0.0	139.6
1995	137.0	139.4	144.4	0.1	1.8	0.1	152.9
2000	143.6	145.9	156.0	0.4	3.7	1.4	167.3

agricultural productivity index increases from 112 in the base period to 144 in 2000 under the low-technology scenario where nominal R&E growth is just offset by inflation. Here the annual productivity growth rate is 1%. Under the baseline scenario, where real R&E grows 3% per year, productivity increases from 112 in the base period to 146 in 2000 at an annual growth rate of about 1.1%.

Future Technologies

Because we assume that any new technologies will be produced under the high-technology scenario, we had to ascertain what new technologies are being studied by agricultural scientists and whether there will likely be technological breakthroughs by the year 2000. Then we evaluated the potential impacts of new technologies on productivity and incorporated the impacts into the simulation of productivity growth under the high technology scenario.

Several studies have been conducted to identify future agricultural technologies. Wittwer's study on maximum production capacity of food crops identifies ten technologies on the scientific frontier. Photosynthesis and nitrogen fixation are listed as on the leading edge of the frontier.

In a recent study by the Office of Technology Assessment, a panel of scientists representing agricultural and nonagricultural interests, private research organizations, and industries identified three areas of basic research possessing great opportunity for fundamental scientific discoveries. These three areas are photosynthesis, nitrogen fixation, and genetic engineering for plants.

The Economic Research Service also conducted a study in cooperation with Resources for the Future and the Ford Foundation in 1974 (Cline 1974). Researchers in the Agricultural Research Service, the Cooperative State Research Service, and the Cooperative Extension Service were interviewed using modified Delphi and relevance tree methods. Initially, twelve emerging technologies were identified as having significant potential for impacting agricultural productivity. However, most researchers felt that many of these emerging technologies would merely maintain the present productivity trend in the face of new environmental constraints. As a result, the impacts of these technologies already are captured in the base projections. Only four technologies were considered to have the potential for unprecedented impact on agricultural productivity: photosynthesis, nitrogren fixation, bioregulators, and twinning of beef cattle. Since photosynthesis and nitrogen fixation are closely related, we combined them into a single technology—photosynthesis. These three technologies are included in our impact analysis.

To estimate and incorporate impacts of the emerging technologies in the productivity projections, we estimated the probability of each new technology coming on stream in each future year, the expected adoption profile, specific crops or livestock impacted by the technology, increase in productivity of the affected commodities, and the output of affected commodities as a percentage of total output. From this information we derived the potential impact of each emerging technology on productivity growth as well as the total expected increase in productivity due to the adoption of all three technologies in a specific year.

The expected increases in productivity due to photosynthesis, bioregulators, and twinning, respectively, are presented in columns 4 to 6 of table 1. Column 3 shows the projected productivity index under the high technology scenario where the impacts of the three technologies are incorporated into the productivity projection. Column 7 shows the productivity projections if all three technologies become available for adoption with certainty in the earliest year mentioned either in the literature or by the agricultural researchers interviewed. Thus, column 7 provides the most optimistic productivity projections from our study.

For year 2000, the expected increases in productivity due to the impacts of photosynthesis, bioregulators, and twinning are 0.4, 3.6, and 1.4 index points, respectively. If the three emerging technologies become commercially available for adoption as anticipated, their impacts would cause the productivity growth curve to shift to a new S-shaped curve. But, since most of these technologies would not be ready for commercial adoption until the 1990s and since it takes decades to complete the adoption processes, their impacts on agricultural productivity would be small by the year 2000. As shown in column 3, productivity would grow from 112 in the base years to 156 in 2000 at an average rate of 1.3% per year. This growth rate is less than the historical rate of 1.5% for the past fifty years. However, if we project this growth pattern to the year 2025 to allow more time for widespread adoption of the new technologies, productivity would be expected to grow an average of 1.5% per year. About the same growth rate can also be achieved before year 2000 under the most optimistic projection shown in column 7.

Economic Benefits of R&E Investments

Historically, we have had a feast-or-famine attitude about the world food situation and thus about our need or opportunities for increasing productivity in U.S. agriculture. With amazing regularity, some analysts have swung between the extreme views that agriculture has a chronic, built-in capacity for overproduction or that it has an equally durable characteristic for underproduction leading to food scarcity. Accepting the chronic overproduction view would lead one to conclude that R&E has a very low return in food and agriculture and that, surely, better uses could be found for limited public funds. Conversely, the scarcity position would indicate extremely high returns and call for massive doses of R&E, because what more pressing need could there be for public funds than to insure the basic means of human survival. It is only in accepting the scenario of a food supply-demand manageable future that equating the rate of return on R&E with its opportunity costs takes on meaning. Thus, we applaud this current effort to measure the value of public research and extension programs in U.S. food and agriculture because it fits our conclusion that we have a very manageable food future in which the extremes of chronic overcapacity and scarcity can be avoided.

We caution our audience, however, that the *ex ante* measurement of rates of return on R&E is the weakest part of our analysis. This is true partly because it is the most preliminary part of our work and partly because of the professional disagreement as to the appropriateness of consumer and producer surpluses as measures of social benefits. But nevertheless, we do think these preliminary results are worth reporting.

Based on agricultural productivity growth projected under alternative scenarios, the ESCS National-Interregional Agricultural Projections (NIRAP) system is used to project the resulting supply-demand interaction and resulting farm output and prices. These economic projections are then used to estimate social benefits, benefit/cost ratios, and the rate of return on R&E where social benefits are defined as the sum of consumers' and producers' surpluses.

Higher productivity resulting from greater R&E enables farmers to produce more food and fiber with the same quantity of resources or to supply more food and fiber at each price level. Thus, productivity growth shifts the supply function to the right. Comparing the baseline and the high technology scenarios, we estimate that in the one year 2000, farm output would increase 3.0 index points from 165 (1967 = 100) under the baseline to 168 under the high technology scenario.

With higher output and an inelastic demand for food and fiber, prices received by farmers decline, consumer's surplus increases, and producer's surplus declines. In year 2000, for example, moving from the baseline to the high technology scenario causes consumer's surplus to increase $27.9 billion in 1974 constant dollars, but producer's surplus decreases $11.1 billion. Thus, social benefits, measured as the sum of consumer and producer surpluses, increase $16.8 billion.

However, to achieve higher productivity growth under the high technology scenario, the public increases R&E 7% per year compared to 3% under the baseline and this results in \$3.1 billion greater program costs than under the baseline in year 2000. Thus, for the one year 2000, the total social direct economic benefits, net of program costs, of today selecting the high-technology option over the baseline would be \$13.7 billion (\$16.8B–\$3.1B).

To compute benefit/cost ratios, the stream of future annual social benefits and program costs from 1978 to 2000 are discounted at 6% per year. The discounted present value of the social benefits is estimated as \$41.4 billion and the discounted present value of the program cost is \$12.4 billion. Dividing the discounted present value of the social benefits by the present value of program costs yields the benefit/cost ratio of 3.3.

We also estimated the internal rate of return to increased R&E. The internal rate of return as we move from no growth in R&E to the baseline real growth of 3% is estimated at 10% and, in moving from the baseline to the high technology scenario and accompanying 7% per year increase in R&E is estimated at 15%. The internal rate of return for the high technology scenario of increasing R&E 7% per year compared to maintaining zero real growth in R&E is 25%. This suggests that if demand grows in the neighborhood of the baseline level of 2.7% per year, then increases in real public R&E expenditures could increase to 7% per year and still earn a very favorable return on investment. This is fairly consistent with a much more detailed recent analysis by Knutson and Tweeten.

Summary and Conclusions

This paper evaluates the impacts of public research and extension (R&E) expenditures on productivity growth in U.S. agriculture and provides *ex ante* estimates of the rate of return to R&E investment and benefit/cost ratios.

Our baseline projections indicate that productivity will continue to grow 1.1% per year over the next twenty-two years, which is considerably less than the 1.5% growth rate over the last half century. But with a higher 7% per year increase in real public R&E expenditures and assuming that three unprecedented technologies—photosynthesis, bioregulators, and twinning of beef cattle—come on stream as predicted, the annual growth rate over the next twenty-two years would be 1.3%, which is still less than the historical growth rate. But if we project our alternative futures beyond the year 2000 to allow more time for adoption, productivity could be expected to grow 1.5% per year for the next fifty years, which is the same rate we have experienced during the past fifty years. Or, alternatively, if we assume that the three unprecedented technologies become available for commercial adoption in the earliest dates indicated by scientists, productivity could grow more than 1.5% a year through the year 2000.

The internal rate of return to public agricultural R&E investments under the high technology scenario compared to no R&E growth is 25%, and the internal rate of return of moving from the baseline to the high technology scenario is estimated at 15%. Benefit/cost ratio estimates for the above two examples are 3.4 and 3.3, respectively.

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Discussion

R. F. Hutton

There are no startling new techniques nor results in any of the three papers presented here. The simulation techniques employed by Lu, Quance, and Liu appear to be a promising step toward *ex ante* analysis. The emphasis on the *ex ante* in both this paper and Araji's is encouraging.

The Lu-Quance-Liu and Araji papers presented findings that demonstrate again the long lead time required in research. The idea that research in photosynthesis and nitrogen fixation will not be likely to bear fruit of consequence until we are into the next century requires a statesmanship attitude toward research support and its administration. It is not the kind of thing that will produce results that will help get a legislator reelected or give a Secretary of Agriculture or a college dean "good press." Unfortunately, this kind of evidence may tend also to lower the priority of such activity in a Zero Base Budget (ZBB) environment.

I would very much like to accept the high marginal rates for extension estimated by Huffman but cannot since I am unwilling to accept his estimate of negative marginal rates. I cannot logically deduce how this is possible. There surely were not so many extension workers that their visits to farms interfered with productive work. I cannot believe that North Carolina extension workers gave uniquely bad advice. Therefore, I suspect the model, the data, or both. I believe that Huffman should be encouraged strongly to follow his own suggestion to move to more recent data. However, I am not at all hopeful that any model based upon county aggregates will produce defensible results. There is much diversity within counties and among county extension programs that is observed by such aggregation. I suspect some means of measuring this variability will be essential to explaining extension's productivity.

All the papers referred to the particular data problem related to activities outside the USDA-land grant system. All recognized that the presence of these outside activities may result in an upward bias in the productivity estimates. This problem must be given more attention in the future, particularly since there seems to be a trend toward a relatively greater input from these outside forces. Also there is the probability of a very strong interaction of the public and private parts of the system. This certainly would be the case in research, where the private effort brings to practical commercial fruition the findings of public research. Also many of the private "commercial messages" have their roots in extension recommendations. The costs of the private efforts will be extremely hard to measure since a mixture of objectives are involved and only a part of the cost allocatable to "extension." If there is, has been, or, is to be, a trend toward relatively more private activity, this would be particularly important in using a model of the Lu-Quance-Liu type. In the Araji approach, presumably only the required public input could be identified directly. Huffman's approach is largely unaffected by trend of this sort but his comparisons between states would seem to require a uniform ratio of public to private effort that probably does not exist.

I am concerned with reproducibility of results using Araji's methods. I have found scientists to be able to demonstrate considerable flexibility in their optimism regarding projected outcomes of their research when funding support is at issue. This is not to suggest that the Araji technique is not basically sound, but it suggests to me that we need to be in a position to give reliability estimates as well as the estimates themselves.

Araji's results demonstrate again the importance of the choice of measure of social benefit. The crops that rated 1, 2, 3, 4 in order of benefit/cost (see table 1, Araji's first section), rated 1, 4, 2, 3 in Net Present Worth, and 1, 3, 2, 4 in Internal Rate of Return. In a ZBB environment, where half the proposals are

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funded, a different set of projects would survive for each measure selected.

Araji has added 30% as a continuing cost of the individual research efforts. This is based upon information obtained from the scientific workers he surveyed. I suspect the scientists' responses that led to this estimate may have reflected efforts to maintain all the research in their particular discipline niche. If this is so, then 30% of current efforts or roughly $200,000,000 nationwide would go to support a base costing $10 billion or more. The maintenance rate would thus drop to around 2% rather than 30%.

It is not apparent to me why Lu-Quance-Liu brought weather into their analysis. They report the mean results of 200 probability samplings of weather which should bring the results very close to those obtained by omitting it from the model. Further, there should be interaction between the research and extension activity and the farmers' response to weather. It would be useful to demonstrate this interaction but I do not believe the entry of weather in the Lu-Quance-Liu model is in a form suitable for such application.

Huffman's point that extension's efforts may lead to improvement in allocative efficiency as well as technical efficiency is one that could be important. Unfortunately there appears to be no means of measuring this product from existing secondary data. Moreover, such activity does not necessarily lead to increases in output and may in fact lead to output reduction. Under these circumstances, there could be a downward bias in productivity estimates based upon output responses. This matter would seem to justify additional special study. Incidentally, Araji does not appear to consider the seeking of allocative efficiency a relevant goal.

It probably makes little practical difference but Huffman sums the value of extension's contacts with farmers to the beginning of time to obtain the "relevant stock" at any point in time. I would suppose a relevant period would not exceed the span of the oldest living operator who had been influenced by this institution which is of relatively recent origin.

Huffman does not discuss the problem of measuring the input variable. He defines a subset of activities (crops, livestock, and management) but other extension activities, such as youth programs, have at least some content that reflects upon the output variable, possibly with a lag. "Community development" and "rural development" also have a potential bearing. Huffman does recognize the problem of "spillover" between classes he has selected and finds such to be significant. I would suspect that the spillover to and from other classes of activity would be greater than between his classes.

The leading paragraph of Lu-Quance-Liu and statements in Huffman's introduction regarding the size and growth rate of research and extension budgets can be easily misconstrued particularly by those who are inclined in that direction. In relative terms the growth that has occurred and the size that has been attained are very small. The growth in GNP from 1939 to 1972, for example, was about 400% in constant dollar terms compared to the roughly 100% growth in the extension-research investment outlays. Moreover, there is lack of homogeneity in the services provided by research and extension over the period in question (1939–72). The package is much broader in scope and, I think, richer in quality today than it was in 1939. Thus, the public may pay more in an absolute sense but less relative to its income and hopefully less per unit of product. This is said not to suggest that our budgets be exempt from review but rather to place the past growth and projected future growth in the contexts of a generally expanding economy.

Discussion

William W. Wood, Jr.

Interest, both scientific and political, in identifying and measuring impacts is indeed high. Whether we in agricultural economics are up to the challenge, either theoretically or empirically, remains to be seen. Certain implications from the three papers under discussion raise serious doubt. First, comments on the papers.

Araji's paper is based upon the assumption that the main objective of the state agriculture experiment station—and, implicitly, the state cooperative extension—is to promote local economic growth. Such local economic growth is to occur both by increasing efficiency with current technology and more particularly by shifting the applicable technological base. While probably historically true and acceptable, present interest seems to question that assumption. Furthermore, Araji implicitly bases his analysis on the scientist's assumption—albeit, creed—that research results which increase knowledge are "good" or positive and the research question is to quantify how good.

This assumption depends in large measure on the value of resources released. Both economically and socially, resources currently used in agriculture may have very low or even negative opportunity costs. This is particularly true for land, labor, and management.

In Araji's paper, the role of extension is posed as a conventional and narrow one; simply the transferral conduit of information and researchable items. If one views extension as a more integrative factor, the relative values placed upon research and extension may be quite different. If one assumes that the researcher must become even more specialized—narrow in perspective but with increased intensity of expertise—then the extension role becomes that of combining bits of scientific knowledge into a societal problem context. The integrative function may be equally as valuable as the development of any one bit of information.

Huffman directs his attention specifically to extension. Thus, his implicit definition of the extension function as the transfer of information which obtains value only by measured impacts resulting from adoption of specific technology creates a very narrow analysis and may render the results less useful for answering current policy questions. The dismissal of extension education leading to knowledge, attitude change, skills and behavioral change as having limited value—at least in economic terms—can easily be interpreted as an a priori conclusion regarding the societal function of education. An a priori conclusion at this stage seems counter-productive.

In the same context, perhaps the relevant question regarding Huffman's second source of bias is: Does the educational value of extension (other than information transfer) equal or exceed the alleged upward bias in estimates of the marginal value of extension information transfer. An appropriate hypothesis for testing is that the marginal value of this educational function exceeds the value of information transfer.

The potential source of bias mentioned by Huffman is a very critical one—the relationships between extension and other sources of information transfer. Perhaps analysis based upon risk aversion and guarantees of accuracy and reliability is appropriate. Could the value of extension be analyzed in an insurance premium context in which scientific objectivity is the factor against which risk is measured?

Methodologically, the relationships between public expenditures, number of farms and even Cline's estimates of production-oriented extension expenditures upon which Huffman's analysis depends is suspect. Again, these relationships are dependent upon the definition of extension education as well as of farms. While these data may be all that are currently available, reliance upon such a data base and assumed relationships may prove to be spurious.

The Lu-Quance-Liu paper is the projection portion of this session. The authors acknowledge that farm programs and relative prices

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are important variables impacting the rate of technological adoption but excluded them. This is most unfortunate because a reasonable hypothesis is that relative prices may be by far the most significant variable in directing the adoption of technology. Since this is essentially a trend analysis, some attention to relative prices should be included.

The major problem with the Lu paper is not internal but rather the setting in which it must be evaluated. The assumption of the acceptability of increased agricultural productivity and increased technological adoption seems at the heart of many current policy debates. Even the low technology scenario may include a higher level of dependence upon certain technologies than some would prefer. An analysis of mixed technological growth would seem useful if susceptible to identification; decreased use of chemical and fossil fuel-related technologies with an increase in photosynthesis, for example. The current policy debate may not concern all technology, but simply specific manifestations of technology.

All three papers are steeped in the tradition and assumptions of the scientific community. For our profession that translates into efforts to increase economic and technical efficiency. Much of the current debate over the appropriate levels and means of supporting agricultural research and extension with public funds focuses not on efficiency or even the magnitude of consumer surplus, benefit-cost ratios, or rates of return to publicly invested dollars. The policy issues for 1978 and the next few years center on the distribution of consequences.

Indeed, one can make some distributional inferences from Huffman's paper which suggest need for concern over who benefits. This is essentially an equity question: who bears what type of costs and who receives what benefits? When language is included in the Farm Bill calling for "an evaluation of the economic and social consequences," Congress may not know what it wants as a response. However, it becomes rather clear that many interested parties have some notion of what they do not want. One of the items they seem not to want is a statement of the aggregate value of a program which does not address for whom.

Our profession is now trying to measure the value of research and extension for production agriculture. Little or no attention is given to program areas with nonmarket attributes. Unfortunately, our attention is probably a decade or so behind the policy signals even for agriculture programs. While we may be at the "cutting edge" scientifically, one fears that politically, we are too little, too late.

Innovations in Undergraduate and Extension Teaching
(Carl O'Connor, Oregon State University, Chairperson)

Innovations in Teaching: An Introduction

Carl W. O'Connor and Dean N. Osterman

This Invited Papers Session is designed to accomplish two objectives: (*a*) provide specific examples of innovative teaching methods, and (*b*) analyze three alternative methods of teaching. These three methods, simulation, slide-tape, and internships, have been discussed at previous AAEA teaching conferences and, more recently, by Snodgrass and French at the 1974 AAEA meetings. The purpose of this introductory paper in this session is to identify and discuss the meaning, conditions, and process of innovation in teaching.

French proclaims as a truism that students will begin learning when the professor and the profession have been brought together and provide realism for the student. This realism may take a variety of modes, as evident in the three different teaching methods to be explored in this session. However, the best method of teaching and the best method of learning may be different for each individual (teacher and student). Therefore, simply selecting a new method of teaching will not necessarily be innovative relative to solving many acknowledged problems in teaching and learning.

What does innovation mean? Although the teaching approaches to be discussed may not be different, unique, or new to all teachers, they are innovative for those who have not tried them or are inexperienced with their use. Along with presenting the teacher with a new idea, the innovation takes on a new dimension—that of requiring the instructor to reevaluate the objectives to be taught, the audience to be reached, and the best method for communicating the material necessary for this specific audience to master the objectives. Evaluating alternative approaches involves a commitment to students, such as the facilitation of individual rates of learning, and a commitment to improve one's teaching. These innovations mean a change of direction from the present notion of adapting the individual to the instructor's needs, or to administrative convenience. Consequently, adopting new teaching ideas may become an extra burden for some teachers who will feel the need to reorient teaching philosophy, course organization, and learning avenues for students. For others, taking on a new teaching approach may come as a relief. The teaching problems that have prevailed for years may now be resolved by utilizing new approaches. Certainly, new insights may be derived by those instructors using innovative approaches. These new insights are certain to be reflected in more effective teaching/learning procedures, increased opportunities for students to become involved with learning, and a basic feeling that teachers are doing their job; "helping students to learn" (Osterman).

To use innovative teaching methods effectively, it is necessary for the instructor to develop a total plan that accommodates both the student and the instructor. This means that each teacher must constantly reevaluate his/her adopted method of instruction, if the innovative teaching approach is to survive. Whether the teaching discipline will prove to be sufficiently flexible to accommodate a completely innovative structure remains to be seen. The transition from traditional to innovative for the teacher and student is bound to be difficult for many disciplines. If it is to be accomplished effectively, many associated changes need to be made by utilizing resources, such as instructional consultants, media departments, administrative support, and colleague assistance. Several institutions have created a climate for innovation through

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teacher training projects and centralized instructional improvement centers. As the innovations (such as those that will be described in the following papers) benefit the institution in terms of cost savings and effectiveness, increase learner performance and attitudes, accelerate learning, and produce a definite satisfaction for teachers and students, then setting the climate for innovation will be a good investment.

Given this framework for innovation in teaching, three teaching programs with innovation potential will be presented and evaluated in the following papers of this session. Each is built around the key element, helping students to learn.

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Simulation and Gaming Models: Application in Teaching and Extension Programs

Michael D. Boehlje and Vernon R. Eidman

Management games are an accepted component of the education and training program for students on the university campus as well as participants in extension workshops. Numerous applications in agriculture and agribusiness can be cited including the use of farm management games (Menz and Longworth; Boehlje, Eidman, Walker), grain merchandising and feed supply management games (Babb and Eisgruber), and, more recently, the use of games in area economic development training (Nelson and Doeksen). Our purpose is to evaluate simulation and gaming as an educational tool with reference to educational objectives and learning styles of individual students. The discussion briefly reviews concepts of educational objectives and learning theory, and then moves to the use of simulation and games as educational aids. Two examples of management gaming are reviewed and critiqued. Finally, issues confronted in evaluating the costs and benefits of using gaming procedures will be briefly discussed.

The Educational Process

We perceive the following four objectives as being paramount in most university and adult education programs: (*a*) transfer of facts—this objective involves dissemination of that material which is accepted as factual; (*b*) increase analytical capabilities—in the realm of economics and management, the basic concepts of the scientific method of analysis, logical reasoning, and economic concepts and tools that can be used to solve problems or make decisions are the core of educational activities targeted to accomplish this objective; (*c*) improve capability to integrate—integrating the facts, values, and analytical concepts from a wide spectrum of disciplines including the social, physical and biological sciences is one of the more difficult tasks to be accomplished in the typical agricultural economics undergraduate curriculum or extension program; and (*d*) values clarification—a fourth objective that is found to varying degrees in university classrooms and extension education programs is that of providing information to the participant which will broaden his knowledge base and assist him in assessing the values by which he is guided as to both personal and vocational decisions.

The Experiential Learning Process

Many analysts have attempted to determine how individuals learn (Bruner, Torbert). The experiential learning model presented by Kolb is one such conceptualization of the learning process. The process of experiential learning is perceived to be a four-stage cycle (fig. 1). Concrete experiences provide the basis for both observation and reflection. Based on these observations and reflections, the student forms abstract generalizations—in essence, a "theory"—to explain the concrete experience. Using this theory, the implications and behavior in new experiential situations is deduced. These implications are, in essence, hypotheses which can be tested through experimentation and which also serve as guides to create new experiences which initiate the cycle again.

Because of their hereditary background and developmental environment, most individuals find it difficult to master the skills required in

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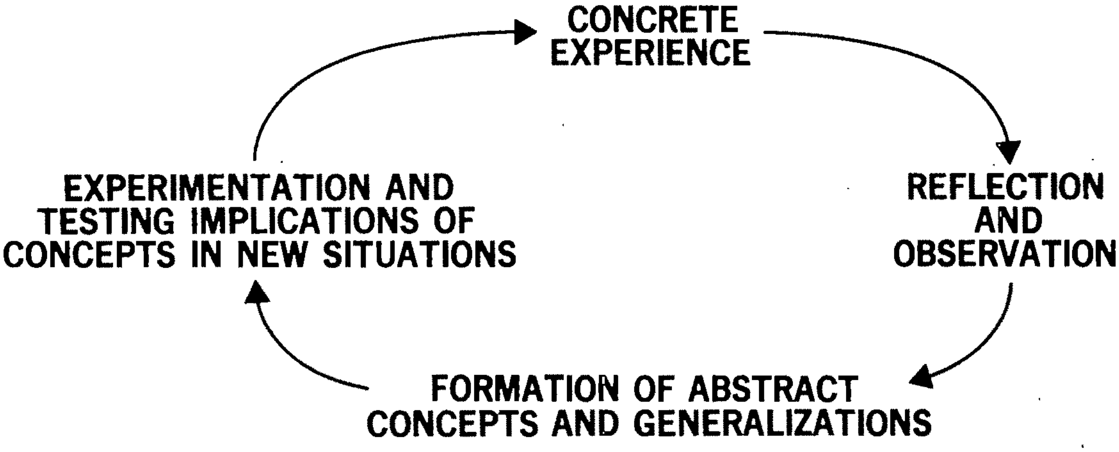
CONCRETE EXPERIENCE
REFLECTION AND OBSERVATION
FORMATION OF ABSTRACT CONCEPTS AND GENERALIZATIONS
EXPERIMENTATION AND TESTING IMPLICATIONS OF CONCEPTS IN NEW SITUATIONS

Figure 1. The experiential learning model

all four phases of the experiential learning process, but excel in one or two phases. Thus, individual learning styles differ depending upon the ability of the individual to perform the various functions in different phases of the learning cycle.

Simulation and gaming procedures facilitate efficiently performing the learning functions in the testing and experimentation and concrete experience phases of the learning process. Gaming enables students to develop and test hypotheses concerning their conceptualization of the problem and its solution. The use of games accelerates the active experimentation and concrete experience phases of the learning process so that additional concepts can be introduced within a given time frame. Having all students participate in active experimentation in the real world would require more field trips and/or other "concrete experience" activities than typically can be accommodated with the time and budget available in most university curriculums or extension conferences. Through the use of the gaming procedure, the benefits of active experimentation, hands-on decision making and "pseudo" concrete experiences can be included in the learning experience.

Contribution of Gaming to the Four Objectives

The use of simulation and gaming contributes to the first three and perhaps the fourth educational objective in management courses. The transfer of facts and accounting and economic principles is typically an important objective in such courses. The initial coverage of a principle allows students to form the abstract concept and generalization. Gaming provides an opportunity to apply the concept, obtain concrete experience, and complete the experiential learning model cycle by observing and reflecting. The understanding of accounting and economic concepts is reinforced if the biological and physical dimensions of the outcome are believable. Thus it is important that the resource base, technological relationships, and input-output prices are lifelike.

Gaming can make major contributions to increasing analytical capabilities and improving students' capability to integrate. Problem identification is a difficult aspect of decision making to teach in a static setting, particularly when the students have not experienced similar situations. Problems of planning, implementation, and control can be introduced rather naturally in a game. Unlike the use of static case situations, students are given an opportunity to experience the result and complete the experiential learning cycle. Learning to interpret the results of such analytical tools as linear programming or decision trees and use the analysis as a basis for decision making is enhanced in a gaming situation. The capability to integrate facts, methods of analysis, and values also is enhanced by the repetitive nature of the decision making.

Relatively little emphasis has been given to the use of gaming and simulation in values clarification in the agricultural economics literature. This probably is due in part to the emphasis placed on the first three objectives, the difficulty of measuring the fourth, and a common attitude that values are given. Emphasis is traditionally placed in management-oriented games on the achievement of business goals, such as rate of return on investment and ending net worth, but "satisfying" behavior and leisure-work goals also may be relevant. Value or goal clarification can be reinforced during the critique of the game through identification of strategies that are consistent with alternative values and the results of following these strategies.

The authors' experience indicates gaming contributes to learning by showing a use for facts, demonstrating a need for the analytical capabilities, providing an opportunity to practice integration, and forcing participants to consider their values in making decisions. The interest and challenge generated by the gaming process carries participants through the cycle of the experiential learning model in a repetitive manner.

Gaming Procedures

The first and perhaps most important aspect in the successful use of gaming is to determine the purpose (or the role) of the game in meeting educational objectives. The purpose is basic to both designing and administering a game. An approach used by the authors and others (Menz and Longworth) is to develop class exercises around a case situation that is also used as the basis for the game. The game is used to generate interest in the exercises and to reinforce learning through repetition. It also adds a dynamic aspect that is normally missed with the case study approach.

Two additional considerations, complexity and whether the game includes competition among decision teams, are important considerations in game design. The complexity of the game tends to increase as the number of decisions, the number of calculations, and the computing complexity increases. The role of the game in meeting course objectives, the knowledge and ability of students, and the amount of time that can be devoted to the game are major considerations in developing a game of appropriate complexity. Frequently, the game can be structured to permit students to deal with increasing complexity in terms of decision alternatives and the decision environment through successive plays.

Most authors agree that participants gain a greater understanding of the concepts through competition among decision teams for resources or market share of sales (Babb and Eisgruber, p. 19; Wilson). In business management games, such competition can occur in the input or product market with emphasis on the role of advertising, promotion, and service as determinants of market share. In farm management games, competition among teams for resources such as land can illustrate concepts of land appraisal and investment analysis.

The proper method and time of introducing the game to the participants are important in game administration. It is probably useful to introduce participants to the mechanics of the game and illustrate play with sample input and output, or to have a "warm-up" play which is disregarded. If the game is constructed around a case situation, the case can be introduced early, allowing students to become familiar with resource availabilities, alternative uses for the resources, and institutional constraints through illustrations and exercises. Team size and composition are also major considerations in game administration. The literature indicates that team size should be small enough that all team members participate in decision making. Composition should be controlled to insure that team members have some diversity of background.

It is important that input be obtained and output returned to participants promptly to avoid loss of interest. Each team member and the game administrator should have a copy of the output from each play. After each play the administrator can evaluate the output and (*a*) discuss reasons for the success and failures that occurred; (*b*) provide modules of instruction on a topic or topics requiring more emphasis; and (*c*) identify teams which need special help. Some teams may become discouraged and lose interest unless the administrator can provide special instruction enabling them to play the game effectively.

After the final play, the game should be critiqued. The critique should focus on integrating subject matter and game experience. To accomplish this, the critique should emphasize the evolution of strategies and policies, the use of analytical techniques in making decisions, the reasons for the outcomes, and the evaluation of the decision making exercise.

The Bank Management Game—An Extension Education Example

The bank management game is a deterministic, multiperiod management-simulation game that typifies the policy management environment of a commercial bank in a rural market. The objectives of using the rural bank management game are to (*a*) provide participants a learning experience in making policy decisions that affect the acquisition and use of funds for rural banks in an environment of changing market conditions and competition from other banks (specific bank management tasks that are tested and reinforced in the game are summarized in table 1); (*b*) increase the participant's appreciation for the tools and payoff of financial planning and analytical decision making in bank asset and liability management; and (*c*) generate discussion during the decision-making process among the bank management team members concerning their reasons for specific decisions.

The management team for each bank must make decisions in two basic areas: price policy with respect to interest rates on loans, time deposits and service charge rates, loan officers' salaries, and advertising expenditures; and investment policy concerning the optimal portfolio of loans and investments. The game includes competition for deposits and loans among the banks. Six-month reports that include specific details concerning the financial performance and progress of the individual bank being managed, the financial conditions of competitors, and the current and expected future economic environment in which the banks must operate are provided to the participants. The detailed computational procedures involved in the bank management simulator are documented elsewhere (Fisher, Boehlje, Roush).

An effort has been made to evaluate quantitatively benefits derived in using the bank management game. The tasks summarized in table 1 were identified to participants in the 1978 Iowa Agricultural Credit School and Iowa School of Banking prior to playing the game as major areas that would be emphasized. The students were asked to evaluate the contribution of the game to their knowledge of and ability to perform each task on a scale of 1 (no contribution) to 5 (substantial contribution). The mean evaluation scores for the two schools are summarized in table 1. Although the array of mean scores from the Iowa Ag-

Table 1. Summary of Bank Management Game Evaluation

	Iowa Agricultural Credit School[a]		Iowa School of Banking	
Task	Total Evaluations	Mean Response	Total Evaluations	Mean Response
1. Cash and liquidity management	57	3.93	46	3.61
2. Pricing of loans	57	3.82	46	3.48
3. Acquisition of deposit funds	57	3.67	45	3.80
4. Analysis of margins (the spread between the costs and returns on funds)	57	4.23[b]	46	3.61[b]
5. Investment portfolio management	57	4.21	46	3.72
6. Loan portfolio management	56	3.41	46	3.11
7. Tax management	56	3.68[b]	46	3.04[b]
8. Evaluation of the impact of competition on profits and performance	57	3.51	45	3.60
9. Evaluation of the impact of the economic environment on profits and performance	57	3.07	46	2.98
10. Assessment of the determinants of loan demand and deposit supply	57	3.46	46	3.37
11. Assessment of the determinants of market share of loans and deposits	57	3.60	46	3.43
12. Understanding of the relationship between the objectives of profit and growth in market share	57	3.75	46	3.69
13. Understanding of the role of planning and analytical tools in bank management	57	3.89	46	3.80
14. Integration of the component tasks of bank management into a comprehensive plan	57	3.77	46	3.65

[a] The array of mean responses for the Iowa Agricultural Credit School is larger than that for the Iowa School of Banking at the 5% level of significance (Mann-Whitney one-tailed U test).

[b] Significantly different between the two schools at the 10% level of significance (Kolmogorov-Smirnov two sample test).

ricultural Credit School is significantly larger than the array for the Iowa School of Banking, the differences between the score distributions for each task are not significant with the exception of tasks 4 and 7. One possible explanation for the lower scores at the Iowa School of Banking is the inability to schedule review sessions after each decision to evaluate the output and answer questions or review decision concepts. Note also the relatively low evaluation score for task 9 and the high scores for tasks 1, 3, and 13. These evaluations by task provide useful insights into the areas where the game is (and is not) contributing to the participants' understanding.

Farm Management Game— A Classroom Example

Farm management games have been more widely discussed in the literature than application of gaming to other areas of instruction in agricultural economics. (For instance, see Boehlje, Eidman, Walker, Eidman et al., Menz and Longworth, Babb and Eisgruber, and Curtis.) This discussion is limited to a game being developed for a northern Corn Belt farm for use in an introductory farm management course at the University of Minnesota.

Many students enrolling in the course are majors in other departments. The only prerequisite is microeconomic principles. A case farm situation is used as the central focus for the course. The game simulates operation of the case farm for up to five years under conditions of price and production uncertainty. The major objectives in using the game are to reinforce the understanding of three accounting statements (the net worth statement, the net income statement, and the cash flow statement), provide an opportunity to apply production economics principles, increase understanding of whole-farm planning procedures and investment analysis, and stimulate interest in the subject matter throughout the course.

The case farm is introduced during the first week of class, but students will not play the game until the latter part of the course after instructional material and exercises on accounting and whole-farm planning have been completed. The game is played using a remote terminal to reduce the administrative time required. The instructor maintains control of the exercise by approving any replays (if a mistake has been made) and by limiting the number of years a participant can complete.

Two decision periods are included in the game for each year, 1 January and 15 August. The program indicates the current situation on 1 January and the participant is asked to input decisions on construction of facilities, purchase of feeder pigs, purchase of corn to feed, annual crop acreages, and sale of crops in storage. The operation is simulated through 15 August, and the participant is provided data on the status of the operation. Participants then input cattle purchase and crop sale decisions for the remainder of the year. The program then summarizes the year's operation and the financial status of the operator. One year's play can be completed by a participant who is familiar with accessing the program and has prepared the decision in approximately twenty minutes. All data are stored in files, making it possible to change the resource base to another farm size, soil type, or geographic area, providing the same enterprises are produced. This feature also means the administrator can either use the game as a simulator or have teams operate different farms to illustrate comparative advantages in production and economies of size.

Evaluating the Payoff of Gaming Techniques

Curtis found combining simulation with the "resource-unit method" improved decision skills among adults. While most evaluations of gaming tend to be quite favorable, they are subjectively given and tend to be provided largely by those instructors who feel use of gaming has been beneficial. This suggests more objective testing is needed in both classroom and extension settings. It is possible to construct tests that measure differential rates of learning facts and knowledge of analytical abilities between teaching methods. However, it is more difficult to test for changes in the individual's capability to integrate facts, analytical capabilities, and values in making decisions.

The resource requirements to use games include development time and costs as well as manpower, computer facilities, and money for materials and computer time when the game is used. The amount of time and money required to use a game depends on the complexity of the game and how it is used. Two observations have been reported for farm management games. The western Oklahoma game farm (Boehlje, Eidman, Walker) required three to four hours of administrative time per student (six to eight hours, per two-person team) and about $10 of processing, printing, and other costs per student. These estimates do not include key punching costs. Menz and Longworth indicate about ninety hours of supervisory time is required to simulate ten farms by month for a five-year period, or nine hours per team. Costs for materials and other items total about $20 per student. The time required to utilize the bank management game discussed earlier includes two hours for introduction, one hour per decision for review and administration, and two hours for a final critique. Material and computer costs are approximately $1 to $2 per student.

The effectiveness of games as educational tools depends on the administration of the game, the consistency between the game and educational objectives, the interface with other teaching tools, and the learning style of the student. If properly used, they are an important tool in the educator's tool kit.

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Designing an Instructional Package: The Use of Probabilities in Farm Decision Making

A. Gene Nelson and Tiffin D. Harris

Developments over the last few years have focused increased interest on the risk inherent in farm decision making. In part this is a renewal of emphasis from the 1950s (Thair, Johnson, Schichele), but it also reflects contemporary phenomena such as increased variation in foreign demand for U.S. grain, changes in governmental agricultural programs, and drought in some of the major agricultural areas of the nation.

The "teachable moment" for farm decision making under risk has arrived. The need for educational programs in this area includes both existing farm producers participating in extension programs and potential farm managers studying in the classroom. A review of the literature (Walker and Nelson), contrasted with a survey of farm management instructors and extension specialists (Walker), indicates the existence of a large gap between theory and practice in risky-farm decision making.

The emphasis of this paper is on the estimation and use of personal probabilities in the decision-making process. The purpose is to describe the rationale and process followed in developing an instructional package dealing with this topic.[1] This paper first reviews the theory and methodology for incorporating probabilities into the decision-making process, i.e., the existing body of knowledge. This is followed by an analysis of the audience and the specification of the instructional objectives which, together with the existing body of knowledge, determine the content for the teaching module. The alternative teaching methods are then discussed, followed by a description of the characteristics of the final package and some preliminary observations regarding evaluation.

Probabilities in Decision Theory

Knight's definitions of risk and uncertainty were based on the decision maker's knowledge of the probability distributions regarding decision outcomes. With the increased acceptance of subjective knowledge, the theoretical distinction between risk and uncertainty is weaker, and the terms are used interchangeably.

There are alternative methods for incorporating the decision maker's personal probability information into the decision model with the payoff matrix and risk preference function (for examples, see Officer and Halter; Hazell; Anderson; Day, Aigner, Smith).

Regardless of which approach is used, probabilistic information is a necessary prerequisite. If the decision maker is to participate actively in the decision-modeling process, he must possess a basic understanding of the concept of probabilities, how they can be estimated, and how they can be used in the context of decision making.

Subjective or personal probabilities are numbers assigned to events which conform to the rules of probability calculus (Savage). These numbers reflect the managers' degree of belief that particular events will occur. These beliefs may be based upon objective evidence, plus informal input from advisors, media, etc. However, to the extent that they are an expression of personal judgment, it is possible that two managers may assign different probabilities to the same event. However, "when two reasonable men have had roughly the same experience with a certain kind of event, they assign it roughly the same proba-

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[1] The module was developed as part of a special needs project funded by SEA-Extension, USDA, and conducted jointly by Oregon State and Oklahoma State Universities. For further information on this and other modules, contact the authors.

bility" (Schlaifer, p. 17). Officer and Anderson (p. 13) argue, "If subjective probabilities are implied in a real behavior, then it is far better to make these explicit in a systematic manner—even if they may not be readily extractable."

Applying Probability Concepts

While there are examples of the estimation and use of probabilities in business management, such as banking (Kabus), the potential of this decision-making aid has yet to be realized in agriculture and agribusiness. Farmers in both Oregon and Oklahoma have responded positively to estimating probabilities for future events.[2] The indication is that farmers, in general, are interested in learning how to use probabilities.

A problem for the educator, however, is the lack of tested approaches for eliciting these subjective probabilities so that they can be used explicitly in the management process. Four possible methods of eliciting probabilities have been identified: (*a*) direct estimation of the probabilities (Francisco and Anderson), (*b*) a cumulative distribution approach (Raiffa), (*c*) use of the triangular probability function (Cassidy, Rogers, McCarthy), and (*d*) assigning "weights" measuring strengths of conviction.

The direct estimation of subjective probabilities can be difficult and frustrating, particularly in cases where more than three events are possible, because of the trial and error procedure which must be followed. The cumulative distribution approach appears to offer possibilities when the events represent a continuous variant, but may be too complicated for those not initiated in probabilities. The use of triangular probability distributions offers some advantages for the efficient quantification of subjective probabilities. However, to make use of this approach in his own budgeting work, the decison maker must compute the probabilities for individual events. The proliferation of programmable pocket calculators may soon make this practical.

A procedure of assigning weights which measure the strengths of conviction that particular events will occur has been successfully tested by the authors with farmer audiences. Briefly, the approach can be summarized as follows: (*a*) discrete events are defined to describe the phenomenon; (*b*) the decision maker is then asked to consider the general shape of his probability distribution, e.g., uniform, normal, skewed right, etc.; (*c*) he assigns a weight of 100 to the most likely event, and assigns weights of 1 to 100 to the remaining events, consistent with his information and beliefs; and (*d*) the weights for each individual event are divided by the total of all the weights to calculate the probability for each event.

This approach is readily teachable to students and farmer audiences, allowing them to quantify their subjective beliefs about the occurrence of future events. However, additional work is needed to compare this approach with others to determine how well it reflects the decision maker's true beliefs.

Analysis of the Audience

One of the first steps in the development of an instructional package is the analysis of the target audience. In this case the concern is with both existing and potential farm managers, a very diverse group. The more important audience characteristics for the purposes here are (*a*) the general level of education, (*b*) the current level of knowledge concerning probabilities, and (*c*) the audience's communication and learning skills.

Farm audiences in general represent levels of education ranging from no high school to graduate training. More than half of U.S. farmers and farm managers, however, have at least a high school education (Flinn and Muñoz). Consequently, the pace, vocabulary, and mathematical manipulations of the probability module were keyed to that level of education. This also makes it adaptable for use in sophomore or junior level farm management courses. A minimum of prior knowledge about probabilities was assumed.

As a group, farm audiences and undergraduate students tend to be action oriented. This orientation indicates a need to present materials in ways that facilitate participation by the audience in the learning process, not only to hold their interest, but to enhance learning, retention, and the transfer of new knowledge to other situations as well.

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[2] In a post-workshop mail survey in Oregon, 91% of the forty-four responding farmers indicated that probability information would be useful to them. Of sixty-one farmers completing evaluation forms in Oklahoma (Holt and Anderson), 64% felt the joint probabilities were the "strongest point of the program." Only three respondents "didn't understand joint probabilities."

Instructional Objectives

Based on the characteristics of the audience and review of literature, the following instructional objectives were delineated as relevant for this teaching package. Participants should be able to (*a*) understand the concept of "personal probabilities," (*b*) follow procedures to estimate their personal probabilities regarding a particular set of events, (*c*) compute the "expected value" for a set of events, (*d*) compute the "cumulative" probabilities, and (*e*) interpret this probability information in the context of a specific decision choice.

Content of the Instructional Package

The information content needed by the audience to accomplish the objectives is drawn from the existing body of knowledge. The presentation of this specific information must comprise a logical sequence of learning experiences, each step building on the learning accomplishments of the participants.

As a starting point in teaching farmers and students how to use probabilities, it is important to make a case for a more systematic approach to decision making under uncertainty. To provide a common definitional ground for the audience, the next step is to define two key words: "event" and "probability." From there, discussion moves to the rules of probability calculus. The distinction is drawn between objective and personal probabilities, and the advantages of using personal probabilities are presented.

Before the participants estimate their personal probabilities regarding a set of events, they first work through the mechanics of preparing a simple frequency distribution and compute the probabilities. To provide a convenient method for visualizing probabilities distributions, the concept of histograms is introduced and used to illustrate the general shapes that distributions can take: normal, skewed, and uniform. Histograms are also used to illustrate how the degree of uncertainty regarding future events affects the shape of the probability distribution.

With this ground work in place, a convenient technique for estimating personal probabilities is then developed. This technique begins with the division of all the possible events into workable intervals. The general shape of the distribution is considered, and weights are assigned which reflect the participant's strength of conviction regarding the occurrence of each event. These weights are then used to compute the probabilities. Cautions that should be employed in estimating probabilities are reviewed.

The remainder of the package deals with the use of personal probabilities to develop additional management information. The first piece of information discussed is the "expected value" of a probability distribution. This concept is defined and the computational procedures explained. The interpretation of the expected value is then related to the shape of the probability distribution. For example, two distributions may have the same expected values, but the amount of risk implied by one can be considerably greater.

Cumulative probabilities, another extension of the personal probability distribution, are then illustrated. This is done in terms of the probability of being below some goal or critical level. Cumulative probabilities are defined and computational procedures explained.

Finally, the expected values and cumulative probabilities for two alternative investments are compared. This application to a specific decision provides a basis for interpreting the meaning of these concepts. The influence of differing risk attitudes among decision makers on the interpretation of probabilistic information is also briefly discussed.

Instructional Methods

Several alternative instructional methods were considered, given the instructional objectives, target audience, and the specific content of the package. The final selection reflects a desire to maximize not only assimilation, retention, and the transfer of learned material, but also the flexibility with which the information can be delivered.

First considered was the development of printed materials only. The envisioned materials included a teacher's manual, a student workbook, handouts, and other take-home materials that could be used by extension agents and classroom instructors to teach probability concepts. It was felt, however, that it was unreasonable to expect extension agents and undergraduate instructors to teach this rather complex subject matter with little or no previous experience.

It was decided that a more guided, prepackaged approach was justified. Moreover, evidence strongly suggests that learning and retention are significantly improved when a combination of sensory inputs are utilized to convey information. For example, when telling is used alone, 70% of the information can be recalled three hours later, but three days later only 10% can be recalled. Similarly, when showing is used alone, 72% is retained after three hours, 20% after three days. However, when a reinforcing mixture of telling and showing is employed, 85% of the information is recalled after three hours, and 65% is retained three days later (Phillips).

For the above reasons, an audio-visual (AV) approach was chosen for the development of the probability module. Within the AV context, then, three major techniques were considered. The first was the use of television. Though the instructional objectives could be accomplished via television (with printed support materials), it was decided that television was not a practical medium. First, the equipment necessary for playback is not generally available or readily portable. Second, for medium and large-sized groups television is not an appropriate medium unless a sufficient number of monitors are available. Third, and most important, the cost of producing television packages relative to other AV approaches was prohibitive.

An audio-tutorial approach would have involved the development of audio tapes which guide students through a set of printed workbook materials. Even though the instructional objectives could be achieved via this approach, audio-tutorial materials are intended primarily for use in situations where a single student works at his own pace. It is desirable for the probability module to have the potential for "self-paced" instruction, yet be designed primarily for use in group situations.

Because of this "multiple use" consideration, it was decided to develop the probability module in a slide/tape format with printed support materials (workbook). From the standpoint of field agents and undergraduate instructors, the slide/tape format offers flexibility in the repeated delivery of the same or slightly modified information. A slide/tape can stand by itself if necessary, or it can be used by more experienced teachers to facilitate communication. High quality, color artwork and photographs are also important to convey effectively the abstract concepts included in the probability module. The equipment used to present slide/tapes is portable and its operation is relatively easy. And finally, the slide/tape medium lends itself well to the development of materials which encourage student participation and feedback.

Module Characteristics

As noted earlier, farmer and student audiences tend to be action-oriented. To hold their interest and teach them probability skills, audience participation in the learning process is essential. Studies have shown that active participation in the learning process (versus passive learning) further enhances comprehension and retention of the material learned (Deterline). The simple "presenting" of information is not enough. Unless the audience is given the opportunity to respond to and work with information presented, with immediate feedback, comprehension and retention are adversely affected.

For these reasons, the ninety-minute module features built-in student participation and feedback. Preprogrammed starts and stops, a student workbook which includes quizzes and exercises, farm-oriented examples, and the direct input of the workshop leader combine to involve and motivate students. As a group, the audience is in control of the learning experience because it can stop the tape at any time for clarification by the workshop leader. The presence of the workshop leader and his direct involvement in the learning process also maintains a beneficial face-to-face interaction between participants and teacher.

The module was developed for maximum flexibility in its combination and use with other modules and materials for various workshops or undergraduate courses. This allows for further enhancing the probability concepts presented in this module through their application in the analysis of specific farm decisions.

Evaluation

As this module was developed, preliminary versions were tested with groups of extension educators from the United States and Canada. Reactions were generally favorable and modifications were made in response to the feedback received. Few of the test participants complained that the material presented was too simple for the target audience, justifying the assumption of a minimum of prior knowledge regarding probability concepts. All respondents indicated that the presentation provides information useful to farmers and most felt that the rationale for using probabilities in decision making is clearly stated.

Much remains to be learned about teaching the estimation and use of probabilities in farm decision making. New educational methods and materials will be developed, and evaluation will indicate their effectiveness. Meanwhile, the testing and revision of this instructional package will continue as a positive first step toward teaching farmers and students the use of probabilities as a management tool.

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Field Experience in Public Affairs Management: The Michigan State University Approach

Lester V. Manderscheid and Bernie Ferres

The concept of earning academic credit for career-related work performed outside the classroom has many names. Internship, cooperative program, field placement, experiential education, work-study program, and field experience are the more common names for such activities. In our program at Michigan State University, we have chosen to use the term "field experience" and this term shall be used throughout this paper. In a session at the 1974 annual meetings dealing with the advantages and disadvantages of field experience, Milton Snodgrass presented as part of his paper the historical background of field experience and included a definition that is still appropriate. "Defined broadly," Snodgrass wrote, "the concept encompasses any off-campus work or study experience with a private business or government agency which is organized by the university for which academic credit and/or pay is received by the student" (p. 1153). Formal programs incorporating field experience into the curriculum have been in existence for over seventy years. The merits of academic credit for field experience are still debated by many academicians and undoubtedly will continue to be argued. Ultimately, the decision to incorporate a field experience component into an agricultural economics curriculum relates to the faculty's definition of education and the value placed on field experience as an integral part of education.

In the Department of Agricultural Economics at Michigan State University, we have concluded that field experience is worthy of academic credit. In this paper we shall describe how the field experience program evolved, the guidelines for doing field experience, how it is managed, the benefits to the student and the department, evaluation problems we have encountered, and recommendations for establishing a field experience.

Background

To place the field experience in perspective, it is necessary to give a brief background of the department major. In 1969 the department faculty renewed their commitment to undergraduate education and designed two new undergraduate majors, food systems economics and management (FSM) and public affairs management (PAM). Both majors, of course, are based on the discipline of economics. The FSM major resembles a traditional undergraduate agricultural economics major except that it takes a systems approach to food that encompasses production of food at the farm level to consumption of food at the table. Graduates of this major generally obtain employment in the private sector with firms that form part of the vast food system. The PAM major is more innovative and indeed many students are surprised to find such a major in a college of agriculture. The impetus for designing such a curriculum arose from the observation and experience of many faculty members that indicated the need for educated people to work in local governments, particularly in rural areas, in state government, in associations dealing with government, and in organizations serving the agricultural community. Certain faculty felt that prospective employees and potential administrators in these areas would benefit from a curriculum that incorporated applied economics and political science. Graduates of PAM could be expected to obtain employment in the public sector at all levels of government. Indeed, two of the graduates in the early 1970s, just as the new major was being implemented, served as prototypes:

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one young man became the representative to the Michigan legislature from a rural area and the other became executive director of the Michigan Beef Industry Commission after managing the legislative campaign of the other student.

As enrollment in the PAM major began to grow, the need for a supervised work experience in governmental agencies became apparent. Students were raising questions about how information they were acquiring in the PAM core courses fit into actually working in a governmental position. Faculty members teaching core courses were presenting enticing case studies and examples based on their own experiences with government. Another stimulus for establishing a field experience component in the curriculum was the very tight job market in 1973–74 and the emphasis placed by employers on relevant work experience. In fact, one PAM student felt that field experience was so essential in the curriculum that he wrote a 60-page paper (for independent study credit) describing the theory, rationale, and structure for the development of a field experience program.

During 1974–75 the College of Agriculture and Natural Resources was developing a college-wide internship program for students to gain career-related experience for credit in a supervised setting. The expectation of the 13th Term Program, as it was called, was that a student would work full time for one term in the private or public sector, be paid a salary, and would earn up to ten term credits. Efforts to utilize the 13th Term Program with government units were frustrated by Civil Service rules and the lack of funds available for paying students in such a program. A great deal of advance work was necessary to develop paying programs in government and obtain commitment by an agency to such a program. Many students were unwilling to take a whole term away from the classroom for such an experience, despite its relevance and potential payoff. Other factors that dampened enthusiasm for the college program were the higher registration fees and the increased costs if the student had to move away from the campus area. However, in the 1974 fall term a placement was secured with a local township government for a student who was willing to do a twenty-hour per week field placement. Both the student and the township supervisor spoke highly of the experience. In the 1975 winter term the undergraduate academic adviser in the Agricultural Economics Department was able to secure a part-time placement for another student with the Tri-County Regional Planning Commission to work on a transportation planning study. This involved twelve hours of work each week for ten weeks for which the student received three academic credits. The student received no money for her work and the credit was earned under PAM 480: Supervised Independent Study. The student gained valuable insights into the working of a regional planning commission and contributed significantly to the completion of an important study for which there was an urgent need. Because of this student's work experience with the Regional Planning Commission and her outstanding academic performance, the academic adviser was able to arrange a full-time, paid placement for 1975 spring term with the Michigan Department of State Highways and Transportation located in Lansing. In this placement the student served as a staff member in the Rail Planning Section and made an important contribution to a state rail plan that was mandated by recent federal legislation. A quote from an eleven-page summary paper submitted by the student as part of the evaluation process indicates the kind of learning that can take place in such a field experience:

> I believe the value of my internship is that I have begun to develop a real understanding of the attitudes and strategies I must develop if I hope to be both an effective professional and be satisfied with my own performance. Although I had been made aware of the pressures and games which exist within the system in some of my classes, seeing it firsthand and being affected by it every day gave me an understanding of its importance which I did not have before. . . . In order to be effective and productive you must fend off all the extraneous struggles, pressures, and hassles with a minimum of your time and energy. (Caswell)

In the fall of 1975 the academic adviser was able to arrange a sixteen hour a week field experience in the Michigan Department of Management and Budget, Office of Intergovernmental Relations, for a young man who worked on analyzing retirement and pension programs for local government employees. This student was subsequently hired by this office as a permanent employee and is making his way up the administrative ladder.

These forays into arranging field experience opportunities for students demonstrated three things: (*a*) the actual learning that could take place in a supervised field experience; (*b*) the benefits obtained by student and agency; and (*c*) the amount of time required by a university representative (academic adviser or faculty member) to arrange work experience of high quality and worthy of academic credit.

An important consideration following from this third point is whether a department can justify the investment required to develop a field experience component in a curriculum. Fortunately, from a department budget perspective, the State Department of Civil Service in Michigan was in the process of developing a program whereby university and college students in Michigan could gain experience working in state government. The Michigan Government Education Internship Program (MGEIP) was established in 1975 with a one-year grant from appropriations under the Intergovernmental Personnel Act. A person was hired as an internship coordinator in the Department of Civil Service and a major part of his time was to be spent working with all the departments in state government to identify internship opportunities for students. Learning-service agreements were worked out which specified the kind of work to be done by the intern.

The development of this state program coincided with a rapid increase in the number of PAM majors and an expressed interest in gaining field experience. The policies of the Michigan Government Internship Program were complementary to expectations that had evolved in our limited use of field experience. Selected statements from the state policy are quoted here:

> The Michigan Government Internship Program shall be based upon the manpower needs of government and the academic requirements of the participating institutions of higher education and students.
>
> A position description will be developed for each internship position. . . . In all internship positions the duty assignments will not involve routine assignments, clerical, or custodial tasks.
>
> The academic merit of an internship program will be adjudged by the college or university concerned. (Michigan Department of Civil Service)

Development of Guidelines for Field Experience

To formalize the program, we developed a set of guidelines which described the procedure for obtaining a field experience placement, for selecting a faculty supervisor, for determining academic credit, and for evaluation of performance. The students enrolled for field experience credits under PAM 480: Supervised Independent Study. They were expected to work for the agency a minimum of four hours/week for ten weeks for each credit earned. Thus, sixteen hours of work per week were worth four academic credits. Most students opted for a four or five credit field experience. As a department, we set nine credits of field experience as the maximum number that could be counted toward the 180 credits required for graduation.

Under PAM 480, grading was on a numerical scale or at the student's option, credit/no credit. The vast majority of students chose to receive a numerical grade. The only bases for grading were the required summary paper evaluating the experience and a daily journal of activities.

Table 1 shows the participation of PAM students in field experience since winter term 1976. To date, we have not had one negative experience in over sixty placements. Agency supervisors who are generally mid-level civil servants or higher have indicated a high degree of satisfaction with the work of the students placed in their offices. The students have responded enthusiastically to the opportunity to practice their skills and apply their knowledge in a professional work environment. All of them have rated the time spent in a government agency as a valuable learning experience. Faculty members have reacted favorably to their supervisory role in the field experience and to the additonal insights that "experienced" students bring back to the classroom.

Management of Field Experience

The vast majority of students doing field experience arrange them through the Michigan Government Internship Program. A few students, either through their own efforts or with the assistance of the academic adviser or a faculty member, perform field experience in other government agencies. In addition, this year we have had two young women participate in the Foreign Agricultural Service's Cooperative Educational Program in Washington, D.C., and another working in Chicago city government. These three experiences have been processed through the college 13th Term Program since the work experiences are full-time, paid employment and away from the campus area.

Table 1. Field Placements—W 1976–SS 1978

	Winter	Spring	Summer	Fall	Total
1976	5 (2W,2B)	11 (3W,2B)	5 (4W,2B)	2 (1W,1B)	23
1977	4 (0W,2B)	11 (5W,3B)	9 (5W,4B)	1 (0W,0B)	25
1978	5 (3W,1B)	9 (6W,2B)	5 (4W,2B)		

Note: W is women; B is black.

Developing a field experience program for our PAM majors has been facilitated by our proximity to the state capital. Most of the state government offices are within a fifteen-minute car or bus ride from the campus. The fact that the Michigan Department of Civil Service created an internship coordinator position also made the development of a field experience program much easier. If we had had to make all of the agency contacts ourselves, we would not have been able to encourage the broad participation that has occurred. We still occasionally make personal contacts for particular students or placements. Our PAM graduates now working in state government have helped promote field experience within their units and facilitate new placement opportunities.

Problems with Evaluation

Throughout the existence of the field experience program, the faculty supervisors have been somewhat uneasy about giving a numerical grade for field experience. And it did not seem desirable to ask the agency supervisors to award an academic grade because they would have little basis for establishing such a grade. Thus, about a year ago we initiated the necessary paperwork to offer field experience under its own course number with grading to be done on a pass or no pass basis. The request was approved at all levels of the university, and starting this summer students enrolled for field experience under PAM 490: Supervised Field Experience. We initiated this request for several reasons. One was to identify field experience on the student's transcript so that employers would be able to separate it from other types of independent study. Another reason was to eliminate the tendency to award a 4.0 (an A grade) for field experience because of the difficulty in assessing an appropriate grade. The pass/no pass grading system is consistent with field experience evaluation in other departments at Michigan State University. Some other departments, however, are more liberal in the credits they allow for field experience. Two majors require a full term of field experience for graduation and the students receive fifteen credits. Two require twelve to twenty-four credits of field experience for graduation while others allow essentially no credit for field experience. We have no plans to make the field experience a required part of the student's academic program. To do so could impose a real placement burden when we do not control the number of majors. Additionally, there are a few students who do not wish to pay for or use academic credits for field experience. Furthermore, most faculty do not deem field experience as important enough to make it mandatory.

Specification of Learning Goals

As our experience with the program increased, we felt a need to structure the learning to some extent. Participation in a university-wide task force on experiential education helped provide a framework around which to add structure and to focus the learning experience. A new set of guidelines has been developed and is being used, effective this summer. Six categories of learning goals have been identified and examples given of concrete learning outcomes that might be involved (Duley and Gordon). These goals and a brief description of each follow.

(*a*) *Specific job competencies.* Particular understanding or work skills you would like to learn.

(*b*) *Career exploration.* First-hand observation of the daily routine of professionals in an area of interest. (Direct involvement in the types of work involved in a field, knowledge of job opportunities that might be available, familiarity with occupational literature and organizations.)

(*c*) *Broadening horizons.* Understanding how the legislative process and the bureaucracy works or fails.

(*d*) *Interpersonal skills*. Learning how to deal with pressure and tension in work relationships and how to communicate what you know.

(*e*) *Taking responsibility*. Learning how to organize a complicated job so that a tight schedule can be met.

(*f*) *Research skills*. How to relate academic knowledge and seek new information to meet the demands of a particular job.

Prior to the start of the field experience, the student is asked to rate the importance of each goal and to list specific learning objectives he or she may have. With this exercise it is hoped the student will begin to assume more responsibility for his or her own learning. About the middle of the term, the student meets with the faculty supervisor to discuss progress made in meeting the objectives. Again, at the end of the term the student and faculty supervisor discuss the field experience in terms of the learning objectives originally specified. We expect that these goals will also help structure the daily journal and the summary paper required of each student.

Some Conclusions and Suggestions

We now have over three years' experience with field experience and feel comfortable offering the following conclusions and suggestions: (*a*) Field experience is a valuable learning environment especially for students with no prior work experience in that environment. (*b*) Work experience may or may not be a significant learning experience. Some structure to identify and evaluate educational outcomes is necessary. (*c*) Field experience can lead directly to full-time employment. (*d*) Development of field experience opportunities can be costly in terms of faculty time. (*e*) Grading on a pass/no pass basis reduced the pressure on faculty to award a numerical or letter grade. (*f*) Field experience probably should not be required of all students.

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Innovations in Undergraduate and Extension Teaching: Discussion

Odell L. Walker

Strong concern persists within this profession for improving teaching, as evidenced by this session and other similar sessions on innovations in teaching at the annual meetings. The emphasis and concern exist throughout the year at teaching departments and in extension groups. The impetus comes from within the profession—faculty and students—and outside, including college deans, colleagues in other disciplines, and employers.

A brief synopsis of recent discussions at annual meetings will give additional perspective to discussion here. In 1974, Snodgrass and French each presented excellent papers on taking the student to the real world or bringing the real world to the student. Discussion in the 1975 meeting centered on the nature of the graduate wanted by diverse employers and how to provide the desired product (Luby). In 1977, Roberts and Lee presented a study of student and teacher thinking and learning psychology and suggested implications for teaching strategies. The papers from all these sessions are recommended for review.

It is no surprise that all the questions and problems are not resolved despite past efforts. Students vary in prior education, motivation, goals, academic ability, experience, and skills. There is not a perfect fit between teaching strategy and result even when the nature of the teaching situation is given. Time and resource constraints exist for students and faculty. Students have limited years to spend and courses to take. Great discipline is required to avoid proliferation of courses. Faculty must publish as well as teach and there is a limit on time devoted to teaching. Uncertainty exists about future needs of graduates. Returning graduates frequently cite the need for other training, e.g., better communicative skills and more mathematics, accounting, and general training, as well as proficiency in the discipline (Luby). Thus, more than one curriculum and teaching strategy is defensible.

Because the whole process is not certain and the teaching science is inexact, it is appropriate to continue searching and studying innovations, as in this annual meeting. The papers in today's session collectively identify and evaluate issues relating to what and how to teach. I will comment on each paper in the order presented.

Simulation and Gaming

Boehlje and Eidman have been active in developing, using, and evaluating games. They are successful teachers but have the talent, I suspect, to do a good teaching job with a lectern and a few hard benches. In the paper, they place much of the argument for using games on the existence of multiple educational objectives and varied learning styles and processes. Techniques for using gaming are reviewed and two games used in agricultural economics are summarized. They close with a call for studies which objectively evaluate the benefits of gaming as a teaching aid. I have no major quarrels with the content of the paper, but will review a few points before presenting some experiences with and feelings about gaming.

It is not clear to me that gaming offers any particular advantage in introducing multiple decision objectives or contributing to "values clarification" as suggested by the authors. Use of the game as a simulator might demonstrate the effect that alternative values embodied in specific decision rules have on the pattern of results over time. Class time frequently limits the extent to which the study of economic choice can be generalized to broad classes of goals and values. In my opinion, the "values clarification" objective mentioned in univer-

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sity teaching objectives is probably not oriented to economics but to forming a philosophy of life and preparing to live with one's self, other people, and the world as it exists (Snodgrass).

In addition to the work of Kolb, literature on learning principles deserves attention when evaluating teaching tools. Some of these principles were used by Schneeberger in 1968 to evaluate gaming and the Oklahoma Farm Management Game. Learning principles stress the conditions which lead to learning such as: intensity—using as many of the senses as possible; organization—vertical reiteration, building on previous learning and experiences; exercise—providing practice and experience; and, effect—achieving satisfaction from learning by using the knowledge and/or enjoying the learning experience. Skillfully used, gaming can rate high by these principles.

In their discussion of how to manage the gaming exercise, the authors offered some useful guidelines. More assistance is needed in choosing the complexity of the game. Specifically, complex games confound so many separate teaching objectives that the professor and student cannot sort them out. It is possible to develop games that illustrate one or two ideas or concepts and require a small amount of explanation and administrative time. As emphasized later in this discussion, time is an important consideration in using games. Advanced computerized games with teaching points related to experience with the "real world," decision analysis, practice, records and records analysis, financial planning, control, implementation, and capital budgeting (to name a few) might be saved for the graduating senior who is ready for his "final exam."

Eidman's experience with using games shows in the description of the new farm management game for Minnesota. The objectives are manageable and reasonable ones for first-year students. Recognition of the substantial faculty time requirement in gaming is reflected by the proposed use of a remote terminal. Reality has been added by including two decision points in a year. Apparently, the time required to play the game is short and the farm resource situation and the distribution of random events can be varied to avoid having the "school solution" passed across semesters and generations.

Schneeberger reports on some early evaluations of games in his literature review. Debertin and others at Purdue and Kentucky have used games experimentally to measure the effect of research information and feedback from previous decisions on profits generated in a farm management game. To evaluate the effect of gaming on profits, an experiment could be designed to hold information constant and compare the performance of experienced management gamers with other groups.

My experience with gaming began with a hand-computed game in 1965 (Walker and Halbrook). We used hand-computed and then a computerized game in the farm management class until 1975, and for several years the course was built around examples from the game farm. The students liked the game and it provided a good orientation to the farm decision environment and year-to-year cash flow problems in an uncertain environment. There is no question in my mind that the students left with a strong intuitive feel for management under uncertainty. But, I was not sure they had enough concepts and analytical tools to use. I am concerned with the trade-off of scarce time for gaming rather than additional concepts.

In 1975, we revised the farm management curriculum to coordinate content in three semester courses. Farm Management I includes production economics principles, records, tax management, enterprise budgets, budgeting, and resource acquisition. Agricultural Finance covers capital requirements in agriculture, tools and concepts of financial management and applications to agriculture, business organization, and estate planning. Farm Management II includes decision making under uncertainty and decision theory, farm planning using linear programming, and selected problems in planning, implementation, and control. The latter includes labor-personnel management, getting established in farming and planning for growth, father-son arrangements, capital budgeting of investments on the farm, and using records in the farm control function. The first course, and frequently the second, serves nonmajors.

We are not regularly using the farm management game in the classes, but are using the bank game in Agricultural Finance as a project option outside of class. With the division of so many topics among the three courses, there does not seem to be room for gaming. Something must be given up to use a game in a given course structure. Gaming requires more interaction of the professor and students than the single purpose homework exercises I use in my nonlab class. Although I am impressed with the argument that it is better to teach a few topics well than many superficially, I do not know the trade-offs or which topics should be slighted.

The cost of designing and building a good game is high. It must be thoroughly understood by the professor(s) using it to teach. Thus, a great deal of human and other capital is invested. When a faculty member moves or starts teaching a different course, the investment may be lost. New faculty may have other interests or simply not make the investment to learn the intricacies of the game, and the game is shelved. Another reason games get shelved is because they become outdated as farm programs and economic situations built in the game change. Sometimes new computer hardware and software make games inoperable. Thus, there are costs of keeping the game and the user up to date.

An attractive strategy to me is to capture the essence of gaming in short and specific game-type exercises. Personal interest and involvement of the student, real world-like experience, dynamics and uncertainty, application of concepts and techniques, feedback, and managerial practice can be obtained in such exercises. Students who want more "experience" could be offered a one or two hour module that uses gaming. The module would have few lectures and use as much autotutoral work as possible. Students would be required to have appropriate prerequisite courses and emphasis would be on an application of knowledge and on practice in a realistic environment. Grading should be on *ex ante* reasoning rather than *ex post* results in a stochastic game.

In teaching decision making under uncertainty, simulation of the results of alternative decisions and strategic concepts could be very useful. It is difficult to visualize and contrast the result of flexibility, high financial reserves, insurance, or diversification strategies over time. Within a game used by a class, simulations can be developed to demonstrate that a strategy performs as advertised. An understanding of the environmental situation, which the students using the game would have, would enhance the usefulness of the simulations compared to cold research results from another source.

The Probability Module

Gene Nelson has been a good worker and leader and Tiff Harris has been a valuable resource person and worker in a federal extension-sponsored project on dealing with risk in farm decision making. This project was jointly conducted by Oregon State University and Oklahoma State University. A number of other people around the country have made strong contributions.

The paper by Nelson and Harris shares one product of the project, specifically the module for teaching probability concepts and uses to farmers and prospective farmers. I am not unbiased concerning this paper, having had the privilege of reviewing this and other modules developed in the project. I was involved in the project to some extent and have experimented with the materials and techniques for teaching probability concepts to junior-senior farm management students. The probability module is a welcome addition to materials in this subject area.

Nelson and Harris review the role of probability in decision making and present arguments for identifying and using objective probabilities. They then report on the development of the module, including analysis of the potential audiences, instructional objectives, content, instructional methods, special module characteristics, and some preliminary evaluations.

I certainly support the push to increase the ability of decision makers to use probabilities. However, emphasis on the fact that probabilities may be personal or subjective should not be overdone. The main logic is that it is very hard to identify any probability as strictly objective. For example, information is always selectively processed and interpreted in formulating probabilities based on historical frequencies. The result can hardly be called objective rather than judgmental. Emphasis should be on careful observation and processing information at hand and on specification of probabilities consistent with the rules of probability and the beliefs of the user. The implication that some probabilities occur in a dream or are frivolous should not be perpetuated by the terminology we choose to use in talking about them. I prefer to avoid the term personal probability. Subjective is slightly better.

The first application of probabilities, once they are elicited, is usually to formulate an expected value. A teaching module may be needed on mastering the calculation and interpretation of the expected value. What meaning does expected value have in the case of the one-time decision versus a situation in which many similar decisions are to be made? The use of the whole probability distribution for analyzing outcomes of a decision needs to be stressed. My students seem to look skeptically at decision procedures which maximize expected value until they learn the possible joint use of expected values and the safety first rule.

Several extension workers have educational programs that teach and use probability concepts. Roy Black and colleagues at Michigan State University use probabilities in pricing workshops. Anderson and Holt used joint probabilities in their computerized decision tree model for comparing enterprise alternatives. I am sure that they and many others who use probabilities will welcome this carefully conceived module for teaching probabilities.

Field Experience

The Manderscheid and Ferres paper adds to the discussion presented by Snodgrass on field experience at the 1974 annual meetings. Michigan State University has had some valuable experiences which are worth sharing. The program is unique to most of us because the internships are in the public affairs area and are supported by governmental agencies. Few agricultural economics departments have that major.

Apparently, the Michigan faculty felt that the students must acquire field experience in government because (a) these activities were outside their previous experience, (b) requirements by employers for job experience suggest a need, and (*c*) students need to learn how their knowledge can be applied within the sociological-organizational realities of public agencies. The Michigan experience indicates that actual learning does take place, benefits accrue to the students, agencies, and the university, and the program is demanding of teaching-coordinating resources. It is a big problem to develop continuing field opportunities.

Written guidelines for the student cooperator and coordinator are needed according to the Michigan State University experience. Formal guidelines should include statements on the program for the student, the university, and the cooperator. I am impressed with the objectives that were formulated. In the case of the student, the objectives relate to the learning experience and emphasize development of job competency, interpersonal and research skills, and career exploration.

The message I got from the paper is that the authors regard their program as a way to offer a wider range of opportunities for students and employers. They do not recommend that field experience be a requirement and I concur, partly because goals and personalities vary and partly because judgments about what to cut out of a program are too difficult. It is hard to require longer tenure for a student if other students do not have the same requirement. Michigan State allows modest credits for field experience, and, by using the pass-fail option, they are careful not to let the grade in the course unduly influence matriculation progress. It is possible that their conservatism in that area reflects some concern for the academic nature of the credit.

The authors do not indicate why the Michigan State University field experiment program is confined to the public affairs majors. Other universities have internships with banks and agribusiness. I see no unique requirement in the public affairs program for field experience compared to the more traditional agricultural economics program. However, there might be a need to have students in a field situation to demonstrate to employers what the students are capable of doing. This would be particularly the case if the potential employers in public agencies have not heard much of the agricultural economics curriculum. Also, minority students may need a special opportunity to show their capabilities, and that boost might be provided by the field experience showcase.

In summary, offering field experience opportunities for credit broadens educational alternatives for students in the spirit of serving individual needs and improving the match of learning conditions to learning psychologies. Field experience programs force the faculty to look outside the university, at least in securing field experience opportunities, supervising students, and grading reports, and helps us to keep abreast of industry and governmental developments and make new contacts. The cooperating companies learn more about what students trained in various subdisciplines of agricultural economics can do and get a head start on recruiting.

Field experience programs certainly are not a way of exporting responsibilities and the paper makes that clear. Like most innovative teaching, they take more planning and coordination than showing up for lectures three times a week. The faculty must be willing and the administration able to support substantial time for obtaining cooperators. In most cases, something must be cut from the program to make room for the hours spent on field studies. What will be cut when the important subject matter in the field is in fact expanding rapidly. We must be defensive about the quality of our program and our reputation. It certainly is not necessary for everyone to be in a field experience program, because much enrichment of departmental programs is obtained when only a small percentage actually go into the field.

Summary

I would like to compliment the chairman of the session, the authors, and the audience for participating in this endeavor to improve educational processes in agricultural economics through the innovations discussed. Gaming and field experience have some of the same goals, particularly providing an orientation to the real world. Hopefully, all our case studies, whole farm problems, term problems, farm appraisals, and even homework have that as one goal. The probability module emphasizes that probability is an important subject for farmers and university students and that the audiovisual package is a useful instructional method. As I have indicated, the innovations discussed are attractive. However, questions can be raised about each technique. There is no single answer to how the teaching job should be done.

All instruction which depends on an external person or machine strikes fear in our hearts. Bulbs burn, equipment gets misplaced, computers go down, and people forget. Students are not impressed if twenty minutes of the class time is spent arranging equipment and experimenting with its use. Thus, a reminder is appropriate here to (*a*) learn how to use the equipment or tool before class, (*b*) plan ahead for screen, bulbs, plugs, cords, and machines in working order, and (*c*) get to class early and set up. When the bell rings, act like the impressive show you stage is a "routine ground ball."

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Issues in Marine Resource Value and Capacity Measurement
(Kenneth J. Roberts, Louisiana State University, Chairperson)

Concepts of Value for Marine Recreational Fishing

John F. Dwyer and Michael D. Bowes

Recreation is an important use of marine fisheries resources. U.S. fishermen spent more than 536 million days (including any portion of a day) engaged in saltwater or searun fishing in 1975 (U.S. Fish and Wildlife Service). Public decision makers concerned with the management of these resources face critical decisions that will influence recreational fishing.

The benefit-cost criterion is one guide for making these decisions. This paper focuses on procedures for estimating changes in marine recreational fishing benefits under resource management options. The theoretical basis for such estimation is clear and there are a number of good studies to guide the research. With benefit-cost analysis, it is appropriate to use the maximum willingness of users to pay to measure gains in benefits and minimum desired compensation to measure losses. Thus, when benefits exceed costs, it is possible for those who gain to compensate those who lose, such that no person is worse off and some are better off. These same concepts are applied to market goods such as commercially caught fish, thus making it possible to evaluate changes in benefits resulting from an option that reduces the commercial catch of salmon but increases the catch by sportsmen.

The value of marine recreational fishing experiences depends heavily on their quality and location with respect to users and substitute opportunities. Management options are likely to influence the quality of opportunities in a particular area such as a bay or sound. Thus, it is not appropriate to estimate average values for an activity or a large geographic area, but rather values associated with a particular area.

Willingness of users to pay is the appropriate measure of increase in benefits directly associated with an option (e.g., fishing benefits stemming from an increased stock of fish). Willingness to pay for recreation at an area is ordinarily approximated by an area under the demand curve for use of that area. This includes the actual user fees, if any, plus an approximation of the additional amount that consumers are willing to pay (consumers' surplus) rather than go without using the area. This approximation is likely to be satisfactory for recreation because extracting the full willingness to pay for each unit of the good from consumers would not raise expenditures sufficiently to shift the demand curve (i.e., there would be a small income effect). Willig provides formulas for identifying the error in that approximation.

Willingness to Sell

For evaluation of benefits lost by elimination of existing resources (e.g., fishing benefits lost when a bay becomes severely polluted), it is appropriate to measure the lost benefits in terms of willingness of users to sell, i.e., the minimum compensation required to ensure that present users would be neither better nor worse off after receiving this compensation than they would be without the option being undertaken. Willingness to sell, like willingness to pay, may be approximated by an area under the demand curve. As with willingness to pay, explicit bounds may be set on the approximation using the formulas presented by Willig.

Empirical evidence obtained from surveys

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of recreationists (Hammack and Brown) indicates that willingness to sell exceeds willingness to pay by amounts far in excess of the expected difference. The precise explanation for the wide difference is not yet known, but weakness in the survey instruments seems likely. While accurate measurement of willingness to sell presents numerous difficulties, there is no question that it is the proper measure of lost benefits. From a practical standpoint, it is, at present, best to present willingness to pay as the lower bound estimate of lost benefits from destroyed resources with the recognition that with especially desirable or unique resources this may be a significant underestimate of the lost value.

In the absence of market prices for marine recreational fishing, demand is estimated from user behavior (the travel-cost-based approach) or their responses to questions (the survey-based approach). Dwyer, Kelley, and Bowes provide detailed procedures for use of these approaches and discuss the relative merits of each.

The Travel-Cost-Based Method

The travel-cost-based method makes use of a model for predicting use of an area that can be summarized by

$$(1)\quad V_{ij} = f(C_{ij}, T_{ij}, P_j, \phi_i, D_i, Q_j, \mathbf{C}_{ik}, \mathbf{T}_{ik}, \mathbf{Q}_k),$$

where V_{ij} is the number of trips from origin i to area j; C_{ij} is travel cost between the origin i and area j; T_{ij}, travel time from origin i to area j; P_j, the entry fee for use of area j; ϕ_i, the population of origin i; D_i, characteristics of individuals at origin i; Q_j, the quality or characteristics of area j; $\mathbf{C}_{ik}$, the vector of travel costs to all substitute sites ($k \neq j$) available to users from origin i; $\mathbf{T}_{ik}$, the vector of travel times from origin i to substitute areas ($k \neq j$); and $\mathbf{Q}_k$, the vectors of quality characteristics of substitute areas ($k \neq j$).

The model should include those factors that are expected to explain use, particularly the variables likely to be influenced by management options. Estimates of the parameters are based on trips from various origins (i) to an area (j). The wide range of costs and substitutes facing individuals at different distances from an area as well as varying populations at each origin provide considerable information about the influence of these variables on participation. In order to estimate the influence of the quality characteristics, Q_j, it is preferable to estimate the model jointly for a number of areas that have different levels of Q. The model can be used to estimate visitation expected under new or modified conditions, provided that estimates of the relevant variables are available.

An estimated model can be used to derive an aggregate demand curve for each existing area within the region of study by increasing the user fee, P_j, and solving for expected use from the origins.

Significant advances in travel-cost-based methodology include the extensions by Burt and Brewer; Cesario and Knetsch; Knetsch, Brown, and Hansen; and Cicchetti, Fisher, and Smith. These recent models incorporate regional estimation procedures that provide analytical frameworks which take explicit account of alternative recreation opportunities. That is, they jointly estimate the demand for existing areas of various quality, thus allowing the prediction model to account for interaction among areas in attracting visitors. These procedures make it possible to improve significantly on the methodology used by Stevens in his early study of the influence of water quality on benefits from recreational fishing.

The Survey-Based Method

The survey-based method is used to estimate the value of a recreation experience from responses to a questionnaire or a personal interview. It is helpful to view the survey method as having two stages, although they may be combined. An initial survey is aimed at developing a model to predict an individual's willingness to pay for use of an area. Explanatory variables should include those factors that are expected to be altered by the options to be evaluated.

To estimate the value of an existing area, a second survey is aimed at a larger sample in order to identify the user population and values of the explanatory variables. Using the results of this survey and the equation which explains individual willingness to pay, the valuation of each user is calculated and summed to estimate total willingness to pay. Evaluation of a quality change relies upon the estimation of willingness to pay over a wide enough cross-section of quality levels to identify the influence of such a change on the willingness of users to pay. Another survey-based approach to evaluating proposed situations is to pose hypothetical conditions to users and determine their willingness to pay under those conditions. Cicchetti and Smith used this approach to evaluate the impact of alternative levels of congestion on the willingness of users to pay for a wilderness experience.

Past applications of the survey-based method to recreation (Davis 1963, 1964, Hammack and Brown, and McConnell) developed equations to predict an individual's willingness to pay for a visit or season that can be summarized by

$$WTP = g(Q_j, D_j), \quad (2)$$

where WTP is an individual's willingness to pay for visit or season of use; Q_j, the quality or characteristics of area j; and D_j, the characteristics of the users of j.

Variables reflecting travel cost, travel time, and alternatives ordinarily included in the travel-cost-based model are not included in the survey-based model. It is assumed that they are reflected in user responses.

Quality Variables

A number of factors are likely to influence the quality of the fishing experience and many of them may be influenced by management options. Therefore in applying the travel-cost-based and survey-based methods to the evaluation of marine recreational fishing, it is critical that quality [Q_j in expressions (1) and (2)] be given special attention. Stevens found that success ratio at a particular site was a significant determinant of angler participation rates for salmon and steelhead fishing. Brown, Charbonneau, and Hay (1978b) found that number of fish caught was a significant variable in equations for explaining the willingness of users to pay for a number of types of fishing. McConnell and Norton posed additional quality variables to include crowdedness or congestion in the fishing area, services provided by charter industries, composition of the catch, size of fish caught, and weather or sea conditions. The various approaches to reflecting congestion and quality in recreation benefit estimation models are summarized by Ravenscraft and Dwyer (1978a, 1978b).

An expression such as the following might be advanced to explain the quality of marine recreational fishing:

$$Q_j = q(H_j, C_j, W_j, O_j), \quad (3)$$

where H_j is the harvest of fish, in numbers, species, total weight, total length, etc.; C_j, the crowding at area j in numbers of boats or fishermen per unit of area, number of encounters between fishermen, etc.; W_j, weather conditions, average or maximum temperature, cloud cover, etc.; and O_j, sea conditions, wave heights, and tides.

Catch rate, H_j, may be influenced by a number of variables including the stock of fish, number of fishermen, fishing regulations, angler skill, information made available to fishermen, and weather and sea conditions. The skill variable, often measured in terms of experience with the area or activity has been a significant variable in models for evaluating forest recreation (Davis 1963), hunting in Maine (Davis 1964), waterfowl hunting (Hammack and Brown), and beach use (McConnell).

The following expression might be proposed to explain catch rate:

$$H_j = h(S_j, N_j, R_j, L_j, W_j, O_j), \quad (4)$$

where S_j is the stock of fish at area j; N_j, the number of fishermen at area j; R_j, fishing regulations for area j; L_j, angler skill; and W_j and O_j are defined above.

Continuing Research Efforts

Significant improvements continue to be made in the procedures for estimating the willingness of users to pay for recreation opportunities. Major improvements in the travel-cost-based method have included better procedures for building in substitutes, quality, and travel time, and applying the model to new types of situations. The survey-based method has received less attention, but in recent years there has been increased efforts to apply it to fish and wildlife resources and the evaluation of congestion. Much of the recent work on the survey method has been conducted or sponsored by the U.S. Fish and Wildlife Service (Charbonneau and Hay; Brown, Charbonneau, and Hay 1978b). An interesting and potentially useful component of that effort has been directed toward the hedonic pricing approach.

Lancaster proposed an approach to consumer theory that focuses on consumer satisfaction derived from attributes associated with particular goods, rather than the goods themselves. This perspective, which is the basis of hedonic pricing, has intuitive appeal for evaluating changes in the quality attribute of marine recreational fishing.

Hedonic prices for quality are implicit prices of an area's attributes revealed through recreation expenditures by a cross-section of individuals using areas with a range of qualities. The basis for deriving the prices is the presumption that differences in quality will be reflected by differences in user expenditures. In principle, if over all areas there is enough variation in each characteristic of interest, then it is possible to estimate the willingness to pay for a marginal change in those characteristics.

With hedonic pricing, the first task is to establish an empirical hedonic price function linking observed expenditures and area characteristics and use. Second, implicit prices (marginal willingness to pay) are estimated for each user from the quality derivatives of the hedonic price function. Finally, the individual's quality demand function for an area is evaluated by empirically relating an individual's implicit prices and chosen area characteristics and use level. Benefits associated with changes in quality are then evaluated as changes in the areas under each individual's demand curve for quality.

The method is not greatly different than a travel-cost-based approach with quality characteristics included as explanatory variables. This is especially true when travel is a major component of user costs or there is very little variation in other expenditures possible. The experience with using the method for recreation evaluation is at present limited and tentative. The reader is referred to Rosen for the clearest exposition of the theory. Harrison and Rubinfeld offer a good presentation of the method applied to evaluate the costs of pollution through housing prices. There is little published work in the recreation area. Brown, Charbonneau, and Hay (1978a) provide one example. Other work is underway.

Summary and Conclusions

Public decision makers concerned with marine resources continue to face important decisions that promise to affect recreational fishing. Benefit-cost analysis is one of the criteria taken into account when these decisions are evaluated. The willingness of users to pay is the appropriate concept of value for gains in benefits while willingness to accept compensation (willingness to sell) is the appropriate concept for losses. Both concepts can be estimated from a demand curve for recreation at a particular area.

The travel-cost-based and survey-based methods can be used to estimate the demand for and value of marine recreational fishing. Many of the resource management options that are to be evaluated are likely to influence the quality of marine recreational fishing, consequently it is critical that the quality of the fishing experience be reflected in the analysis.

There has been much improvement in the travel-cost-based model over the past two decades and a current resurgence of interest in using the survey-based model to evaluate fish and wildlife resources. Hedonic pricing offers a new and interesting approach to the evaluation of changes in quality.

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The Role of Economic Models in Evaluating Commercial Fishery Resources

Curtis C. Harris, Jr. and Virgil J. Norton

Estimates of the value or changes in value of fish resources are necessary to address various issues related to the utilization, development, and management of these resources. Examples of issues for which such estimates are required are federal fishery research and development project planning, consideration of commercial/recreation or fish/petroleum conflicts, analysis of alternative management strategies for domestic fleets, and domestic/foreign resource allocation decisions.

The Fisheries Conservation and Management Act (FCMA) of 1976[1] set out the decision process for management of fish resources in the U.S. economic zone. The FCMA forms the legal basis for the establishment of quasi-government Regional Fisheries Management Councils. Although the councils are required to develop management plans for all fish stocks within their jurisdiction, final authority for approving and implementing the plan rests with the Secretary of Commerce. This division of responsibility and authority along with the National Standards included in the FCMA almost assure that there will be conflicts and confusion with regard to consideration of national versus regional benefits. The Water Resources Council Principles and Standards (Water Resources Council) for evaluating water- and land-related resources will merely exacerbate these conflicts and confusion.

In the absence of measures of utility, economists have used indirect approaches to estimate resource values. Two commonly used approaches are measures of consumer's willingness-to-pay and measures of market values of economic activity. The typical methods of measuring willingness-to-pay are through producer and consumer surpluses derived from estimated supply and market or compensated demand curves; and surveys where consumers are asked directly what they are willing to pay to gain or prevent an action. Typical measures of market values have been the value of output, value added, and employment.

The willingness-to-pay approach has received a great deal of attention in the economic literature. Conceptual and empirical applications and problems have been extensively addressed and we do not intend to review these discussions here. Rather, because the market-value approach has received little attention as related to fishery questions, and because the market-value approach may be uniquely suited to address certain important issues, we concentrate on the market-value approach in this paper. We discuss input-output models and dynamic econometric models but do not address the associated data and estimating problems. We assume that "goods" and "bads" in the economy can be identified and an appropriate measure of net benefits can be derived from value-added data.[2] In fisheries questions we assume excess labor and capital and nonproductive transactions costs resulting from the lack of resource property rights can be identified (McConnell and Norton).

The Market-Value Approach for the Nation

Actual decisions regarding commercial fisheries tend to result in incremental changes related to specific geographic areas or individual species. However, in order to facilitate discussion in this section, we present an initial hypothetical example which illustrates the implications of eliminating the entire fishery sector.

One measure of the effect on the economy if the fishery industry were eliminated would be the change in value added in the fishery industry. This calculation is based on an extremely

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[1] P.L. 94-265 (90 Stat. 331).

[2] For a thorough discussion of the problems and issues concerning measuring benefits and welfare, see Moss.

Table 1. Illustrative Interindustry Table 1976, in Millions of Dollars

	1	2	3	4	Final Demand		
Sectors	Fish	Food	Other	Quasi	PCE[a]	Other	Total
1. Fishery (SIC 09)	26	288	196	0	781	37	1,328
2. Food (SIC 203)	0	905	732	0	16,791	1,297	19,725
3. Other	330	10,152	3,511,282	0	1,015,940	560,097	5,097,801
4. Quasi	0	0	0	0	56,200	206,000	262,200
Imports	0	1,605	149,038	0	4,238	−154,881	0
Value added	972	6,772	1,436,553	262,200	—	—	1,706,500
Output	1,328	19,725	5,097,801	262,200	1,093,950	612,550	—

Source: Clopper Almon's National Interindustry Forecasting Model (INFORUM), Bureau of Business and Economic Research, University of Maryland.

[a] Personal consumption expenditures.

partial model of the economy, because the loss in value added in the fishery industry could have multiplier effects on other parts of the economy. Also, if the fishermen were reemployed in other industries it is possible that national and regional economies would be better off as measured by the value added. We will examine briefly these changes further through the static input-output model, but then argue that this model is inadequate.

Table 1 is a condensed illustrative national input-output table for 1976.[3] Sector 1 is the domestic fishing industry (SIC 09); sector 2 is canned and frozen food products (SIC 203) which includes processed fish; sector 3 is all other regular industries; and sector 4 is quasi-industries which consists of the government, households, and foreign sectors. The import row includes both noncompetitive and competitive imports. The imports under the personal consumption expenditure (PCE) column represent noncompetitive imports. For simplicity we assumed that all imported fish go directly to a processing plant and this is reflected in the import row of the food column. The sum of the value added row and the combined sum of the final demand column both equal gross national product (GNP).

The next step is to eliminate the fishery industry. We do this by eliminating the fishery column and moving the fishery row down to the import row. Also the Other Final Demand entry for sector 3 is reduced by $101 million, which is an estimate of investment goods bought by the fishery industry in 1976. Government expenditures for fishery management and regulation are not reduced, although a reduction would certainly be implied if the industry were eliminated. It is assumed that personal consumer expenditures are endogenous and that the marginal propensity to consume is equal to the average propensity to consume. A comparison of the value added and employment sector is given in table 2. The total change in value added and employment in the national economy is greater than the value added and employment in the fishery industry because of the multiplier effects of the assumed reduction in final demand.

Either because of adjustments in the private economy or because of direct government actions we would normally expect that workers unemployed in one industry would be reemployed in other industries. Therefore as a next step we allow personal consumer expenditures to increase until the national employment level recovers to what it was in 1976. These new value added and employment figures are also given in table 2. Note that the GNP is $69 million higher without the fishing industry after reemployment than it was in 1976. This indicates lower productivity in fisheries which may in part reflect the results of allowing the fishing industry to operate without resource property rights.

Many assumptions are required to use a static input-output model because there are no functional relationships to derive certain variables. For example, we assume that (*a*) the price of fish would not change; and (*b*) there would be a one-to-one substitution of foreign landed fish for domestic landed fish; (*c*) average propensities to consume would not change; and (*d*) processing plants would process the same quantity of fish. Other assumptions with this same model would have pro-

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[3] Although we indicate this is an illustrative example, it is based on the best available data (Clopper Almon's INFORUM project) and therefore generally reflects the actual interindustry relationships.

Table 2. Value Added (Millions) and Employment (Thousands) in the National Economy under Alternative Assumptions

		With Fishery	No Fishery	
		1976[a]	Unemployment	Reemployment
			$	
1. Fishery	VA	972	—	—
	EMP	53	—	—
2. Food	VA	6,772	6,763	6,784
	EMP	299	299	300
3. Other	VA	1,436,533	1,434,395	1,437,504
	EMP	70,327	70,221	70,373
4. Quasi	VA	262,200	262,093	262,281
	EMP	18,950	18,942	18,956
Total	VA	1,706,500	1,703,251	1,706,569
	EMP	89,629	89,462	89,629
Change	VA	—	−3,249	69
	EMP	—	−167	0

[a] Employment source, U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings, March 1977.*

duced different results and it is possible that under certain assumptions the change in GNP could be negative instead of positive.

In order to obtain better measures of the impact due to changes in fisheries an improved model is needed. For example, a more realistic model would incorporate functional relationships between relative price changes and the consumer and import responses. Also the biological relationships between fish stocks and fish yields necessitate consideration of the dynamics of the system. With a dynamic model the measure of the impact of elimination of the domestic fishing industry would be the difference between the future stream of economic activity without fisheries and what it would have been under baseline assumptions. In this example, the baseline forecasts would be based on fishery conditions prior to the FCMA of 1976. These baseline assumptions are of particular importance, because they reflect the relatively low fish stock levels and associated low productivity in fisheries. A dynamic model, that allows for fish stock recovery and efficient regulatory methods, would result in improved measures, especially if there were allowance for changes in transaction costs.

The Market Value Approach for Regions

The typical approach to regional input-output estimation is to set an assumed level of future final demand and forecast industry output by applying the final demand to the set of fixed technical and trade coefficients. Although this approach may be useful for some types of short-run analysis when small increments in final demand are being considered, it does not seem suitable for long-run analysis which is relevant for the problems in fisheries. Personal consumer expenditures and local government activities are not exogenous, but are related to the earnings that are generated by the industrial output. Investment cannot be predetermined because it is related to output through the production function. Exports and nonlocal government activities are often considered to be exogenous; however, the reason these exports exist is because of the existence of the industry output. For example, there is a demand for export of crabs from the Chesapeake Bay region because that is where the crabs are located. One could argue that if Chesapeake's crab export can be predetermined, production is likewise predetermined.

Personal consumer expenditures and local government expenditures are often made endogenous in input-output models by augmenting the interindustry matrix to include these expenditures as an extra column and adding a corresponding additional income row. But this procedure has the problem of the fixed coefficients; and most important, a fixed relationship between imported goods and locally produced goods. It is not realistic to expect the proportion of imports of each good to remain constant over time. In fact, any time a new industry locates in a region, a change will take place in all of the regional input coefficients that define the relationships among the local industries. Technical input coefficients may remain fairly stable for short time periods, but for long-run forecasting it is necessary to allow them to change. Trade coefficients are even less stable over time. Trade flows are a consequence of the location of supply and demand and transportation costs. Trade flows or any coefficients derived from them do not determine the location of output—the causal relationship is in the other direction.

Even a dynamic input-output model may not be suitable at the regional level. That is, there are differences in the success of a dynamic input-output model at the national level and at the regional level. One reason for this is that the national economy approximates a closed economy; i.e., the dependence on foreign trade compared to GNP is relatively low. This is not true for regions within the United States. In state, county, or metropolitan areas there is a high dependence on trade, and the trade relationships among regions are not the same as trade relationships among nations. Another important difference is that locational mobility among firms and individuals is high within the United States but low between nations.

The objectives of a long-run regional forecasting model should be to make forecasts under baseline assumptions, and to estimate regional economic impacts over time of exogenous events related to industrial or governmental decisions. Such an approach, however, requires an econometric model.

With an econometrical model, improved estimates of the changes in the value added in a region could be made. One possible sequence of events is that the fishermen would become unemployed permanently and income generated in the region would fall, creating a chain of events which would decrease economic activity in other sectors of the economy and cause the region to become depressed. An alternative chain of events is that the initial unemployment of the fishermen attracts a new industry into the area hoping to take advantage of lower wage rates; then the existence of this industry could attract related industries such as regional buyers and suppliers which are higher wage industries, resulting in long-run increases in value added and per capita income.

Elimination of fisheries in one region would affect the economies of other regions as well; therefore, to be useful, the model needs to be interregional in nature.

Operational Dynamic Models

The answer to many questions likely to be raised by the Regional Fisheries Management Councils can be determined through the combined use of Almon's national INFORUM Model (Almon) and Harris' Multiregional, Multi-industry Forecasting Model (Harris). These models have been used to identify impacts of national highway systems, the location of offshore oil production, the opening of new coal mines, and other policy-related questions.

The national model has 200 industry sectors. Technical input-output coefficients are allowed to change over time in response to prices and anticipated changes in technology. Personal consumption expenditures by type are estimated with a set of equations that include disposable income and relative prices as explanatory variables. Investment is related to industry outputs through production functions, and imports and exports depend on income exchange rates and relative prices.

For example, relative to the policy question of allowing foreign ships to land fish in U.S. ports, the national model, with the addition of a new import equation, could be used to show how these direct foreign imports would affect the national economy and domestic fisheries over time. The model would show changes in relative prices and consumer demand and where unemployed fishermen would be reemployed in other sectors of the economy. The national model can be used to evaluate national effects of any proposed decisions that would affect the fishery industry if that decision has measurable or net national consequences.

All decisions have some regional consequences, even those without net national effects, because some regions can gain at the expense of others. The regional imports can be determined with the Harris Model which makes forecasts at the county level for ninety-nine industry sectors. All regional forecasts add to the national totals as given by the Almon Model. The conceptual basis of the Harris Model is presented below in order to provide insight as to how the model would apply to fishery problems.

Assume there are N locations (such as counties) and M commodities. Both producing and consuming activities can take place at the same location. At each supply location k ($k = 1, \ldots, N$) producing commodity i ($i = 1,$

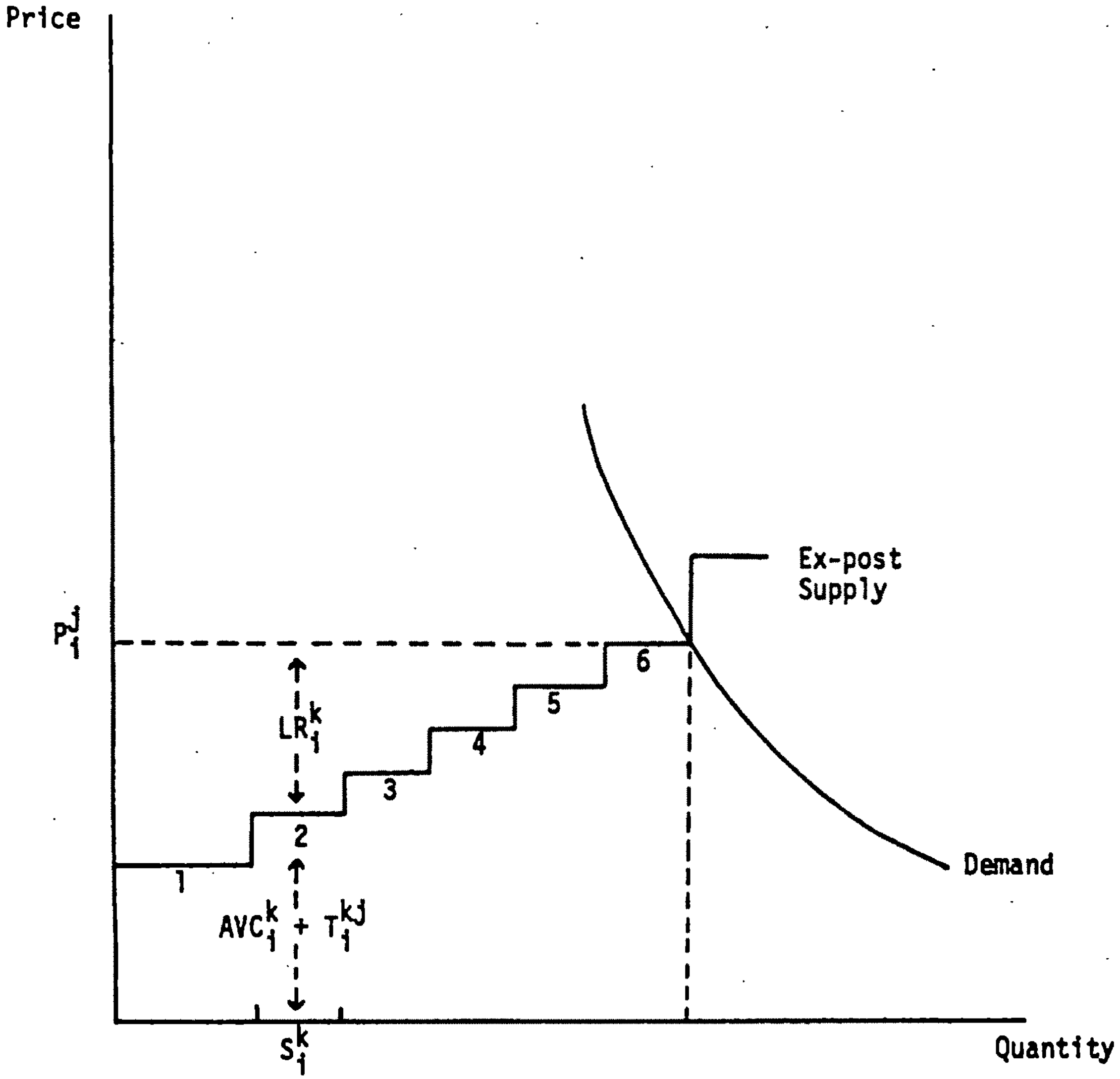

Figure 1. Determination of price in market region j and location rent in supply regions k ($k = 1, \ldots, 6$) for commodity i

. . . , M) there can be any number of firms. The market situation for market location j ($j = 1, \ldots, N$) commodity i, is illustrated in figure 1, which shows that market j is supplied by producers from six supply locations. The step function labeled "ex-post supply" shows the amount supplied by each producing location. The vertical distance of one step is the average variable cost plus the transport cost of shipping a unit of commodity from the supply location to the market location. For example, differences could be due to distance from the port to the fishing grounds, or to regulations that give one port a cost advantage over another (i.e., seasonal quotas for species that migrate along coastal areas). Another example would be cost difference in oyster landings resulting from private leasing in one area compared to open-access oystering elsewhere.

Location rent per unit of output (LR) is defined as the difference between the market price (P) and the average variable cost (AVC) plus transport cost (T). The average variable costs include normal returns on investment and any intrinsic or transactions value of land or the resource in question, but does not include the proportion of resource value associated with location. The definition of location rent is

$$LR_i^k = P_i^j - AVC_i^k - T_i^{kj}. \quad (1)$$

The marginal producing location m establishes the market price, and producers there have zero profits and rental value of land or the resource is zero. In the example in figure 1, the marginal location is 6. Thus, we can define the market price as equal to the average variable cost plus transport cost associated with the marginal location,

$$(2) \qquad P_i^j = AVC_i^m + T_i^{mj}.$$

By substituting (2) into (1) we can redefine location rent at k as

$$(3) \quad LR_i^k = (AVC_i^m - AVC_i^k) + (T_i^{mj} - T_i^{kj}),$$

which shows that the location rent is equal to the difference between the average variable costs at the marginal location and location k plus the difference between the transport costs.

If producing locations have different profits, there is an incentive for change. With fisheries, for example, there could be a number of adjustments, such as: (*a*) changes in the rental value of the rights to the resource due to market or institutional changes; (*b*) firms relocating into more favorable producing locations; (*c*) pressure on the management agency to equalize regulatory effects; and (*d*) incentives to cheat on the regulations in the high cost locations. The model will reflect the impact and implications of these adjustments.

For example, if firms were to move to more favorable locations, initially the supply curves at these locations would shift to the right causing a decrease in market prices. However, the increased production at the favorable locations would create additional demand for labor and wage rates would probably increase. The labor force would relocate in response to the higher wage rates, and the demand for goods and prices at these locations would increase. The increased output of commodity i in the favorable locations would require more inputs, and if the inputs are shipped from more distant suppliers the input prices would go up. The movement of firms in industry i would have an effect on the prices that are paid by other industries that use commodity i, which in turn would have a feedback on the prices of imports used by industry i.

We can conclude that if there is a movement by an industry of outputs to more favorable producing locations, the prices of all commodities and inputs will change, causing location rents and profits to change for all industries in all locations. There is no way theoretically to determine the net magnitude or direction of these changes since both the supply and demand curves for all commodities and inputs shift.

We view these locational changes as a recursive dynamic process. At the beginning of any period there is a set of profits, and industries relocate during the period in response to these profits. The relocations, however, cause changes in all profits, and additional relocations occur in the next period. With fisheries, the biological constraints and alternative regulatory techniques create a special problem. That is, if the producing locations are ports but all ports exploit the same fish stocks, special functions would have to be built into the model to reflect the production constraints and implications of alternative techniques for dealing with some of the common property problems.

The principal driving force in the Harris Model is a set of industry location equations that explain changes in output by region (county). The explanatory variables are a partial measure of location rent, which accounts for the marginal transportation cost of shipping goods out of each region, the marginal transportation costs of obtaining inputs at the place of production, and the cost of labor; the value of land or the right to use the resources; prior investment; prior production; demand; and input scarcity.[4]

Once industry output by region is determined, related variables such as investment, employment, and earnings can be estimated. The model forecasts equipment purchases by industry and construction expenditures by the type of construction. The decision to locate industry output and investment is one and the same, because capital stock is necessary to produce output.

Another major behavioral relationship in the model reflects the location decisions by individuals. Included are equations to explain population migration by age-race group, with the explanatory variables being wage rates, changes in employment, and the amount of labor surplus or deficit.[5] When population shifts have been identified, the model forecasts personal income and personal consumption expenditures.

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[4] Input scarcity is the amount of inputs imported into the region per dollar of output of the industry in questions.

[5] If an area's unemployment rate is higher than the national unemployment rate, there is labor surplus; if it is lower, there is a labor deficit. Forecasts of births and deaths are added to the population to obtain population forecasts.

Plans are underway to expand the number of functional expenditure categories in the government sector, particularly for state and local governments. Also, work is underway to incorporate very detailed information on pollution emissions, and the cost of treating pollution. Then the model can be used to study the impact of changes in pollution standards on the regional economies. The standards affect not only the total amount of industrial activity and fish yields in an area, but also costs of production.

These anticipated changes will make the model even more adaptable to fishery problems by reflecting implications of changing transaction costs and environmental regulations. Further, only minor modifications would be required to examine the special questions related to Canadian/U.S. fish resource allocations. For example, Canadian ports could be added as additional regions. Location rents would be affected by transportation costs (these could be especially important if Canadian vessels operate relatively far south in the U.S. zone, return to Canada, and ship fish back to the United States) and the average cost. Average cost would reflect Canadian subsidies and the transportation cost would include duties and tariffs.

Summary

The discussion in this paper is based on the recognition that there are and increasingly will be pressures to develop regional impact measures for fishery policy decisions. We have purposely sidestepped the issue of conceptual and empirical differences between the willingness-to-pay and market value approaches to deriving value estimates. Instead, we have laid the groundwork for improved regional analysis of fisheries decisions. We have indicated our concern with standard input-output models and even with the applicability of dynamic input-output models to regional questions. Also, any model that cannot identify economic activity generated from nonproductive transaction costs will provide misleading implications.

We conclude that the appropriate approach is one based on econometric relationships and which allows for dynamic and simultaneous adjustment in relevant variables and even coefficients. We presented as an example the Harris Model and indicated how its concept of location rent can be adapted to consider regional fisheries questions. We believe that given the model, the planned adjustments, and appropriate data, the results can provide an important input into many regional issues. We feel that it is necessary to account properly for changes in economic activity before net benefits can be derived.

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Theoretical and Empirical Considerations for Estimating Capacity and Capacity Utilization in Commercial Fisheries

Fred J. Prochaska

Capacity and capacity utilization within firms and industries historically has been an important consideration in economics. Their importance and application to fishery problems has increased considerably in recent years. Economic efficiency is often discussed in terms of optimum capacity. Supply responses are predicted on the basis of capacity for given changes in market and fish stock conditions. Comparisons of capacity with available fish stocks are often made for purposes of determining investment potential and required credit sources. Perhaps the most important area being addressed today where capacity considerations are of importance is the development of fishery management plans for the U.S. fishery conservation zone.

The Fishery Conservation and Management Act of 1976 (hereafter referred to as FCMA) requires plans proposed by Fishery Management Councils to "assess and specify the capacity and the extent to which fishing vessels of the United States on an annual basis will harvest the optimum yield" (U.S. Congress, p. 38). This assessment and specification of capacity is important in determining appropriate management regulations which may be imposed on domestic fisheries and in determining the allowable level of foreign catch. In addition, economic efficiency is considered in determining optimum yield and probable effects of proposed regulations. The purpose of this paper is to address the question of capacity with particular reference to the development of fishery management plans. The discussion is divided into three parts. First, the theoretical construct of capacity will be examined. The second part is a discussion of methodological problems in empirical measurement. The final section contains a review of measures of capacity used in a sample of fishery management plans.

Theoretical and Conceptual Considerations

The state of economic science with respect to capacity considerations has been summarized by Stigler as follows: "The notion of capacity is widely used, but seldom defined precisely. Yet it is an ambiguous concept even at best" (p. 156). In fishery or marine economics, the question of capacity is generally addressed in terms of a bioeconomic or equilibrium-yield framework. Here, in its simplest form, catch or landings are related through an industry or an aggregate production relationship to units of effort. The data base is a time series of production and effort variables, and often some adjustment variables are included for stock or related biological and environmental conditions. This physical relationship is examined along with prices and costs to determine maximum economic yield and the most efficient or profitable level of effort. Optimum capacity is then determined and implications are made with respect to over or under capacity in the total industry.

The more general body of economic theory approaches the question of capacity from the viewpoint of the individual firm. The most frequent definition of economic capacity in the short-run refers to the output level indicated by the minimum cost position on the short-run average total cost curve. This definition, as such, is a value concept to be distinguished from optimum physical capacity which occurs at the point of absolute diminishing returns.

In the long run, optimum economic capacity generally refers to the scale of plant at which long-run average cost is a minimum. An alternative long-run economic capacity position is

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defined to be the level of output where short-run and long-run marginal costs are equal and the short-run average cost curve is tangent to the long-run average cost curve at an output rate where average cost is above the minimum. Of course, for this to be a stable equilibrium, entry into the industry must be restricted. Otherwise, entry of new firms theoretically will drive prices down to the level where the former definition of long-run optimum capacity will prevail.

Output capacity defined for the individual firm may be aggregated to determine total industry capacity. Such an aggregation, however, gives a measure of capacity at one horizontal level in the total system. For completeness of analysis the definition or concept of capacity needs to be further expanded for two reasons. First, output or product prices must be considered because expected prices obviously affect long-run industry capacity in terms of investments in plant and equipment. Prices also affect the level of output or utilization of existing physical capacity in the short run. Second, capacity throughout the system must be considered because capacity limitations at one level in the vertical structure of the system will limit volumes throughout the remaining levels. The question of capacity and capacity utilization must then be addressed in the context of the total system.

Investments in vessels, gear, and other determinants of capacity in the harvesting sector and the extent of capacity utilization are a function of expected catch per unit of effort, input prices (including capital items), and dockside prices. The first two variables affect average cost and thus the level of capacity and capacity utilization. Currently, an important input price likely to affect U.S. fisheries is the price of energy. Alternative sizes and types of engines and alternative power sources, such as sail, will likely require modifications of vessel size and construction. This may affect the capacity of the fleet. Catch per unit of effort is a function of both units of effort and stock levels to which effort is applied. Thus, stock levels should be considered as determinants of economic capacity. They in part determine catch per unit of effort and thus determine average cost per unit of output which is used as the basis for determining economic capacity.

Dockside or ex-vessel prices directly affect through profits the rate of capacity utilization in the short run and the level of capacity in the long run.[1] Demand for raw fishery products from fishermen is a derived demand; thus, dockside prices relate the harvesting sector to the processing and marketing sectors. Fishery products from the harvesting sector are considered as inputs into the "production" process of the processing and marketing sectors. Demand for fishermen's product is then a function of prices of other inputs, substitutability of inputs in processing and consumer or retail market prices. There is relatively little substitution of inputs for raw fishery products except for products where specific species are not identified, such as the market for fish sticks. In this case, supply and demand for substitute species affects prices for the species being considered. The question of the effect of imports on domestic ex-vessel prices is of importance in this respect because imports may compete in the market system directly with specific species or indirectly in the unidentifiable species product market.

Retail price flexibilities or elasticities reflect the capacity of the market to absorb various quantities of fishery products. Retail prices affect optimum capacity and rate of capacity utilization in the processing and marketing sectors. In addition, profitability of processing alternative products limits the processors' ability to process or handle lower valued products from other fisheries. In cases where there is an absolute physical limit in the processing sector due to plant, equipment, and other input constraints such as qualified labor, quotas may be put on the harvesting sector. Once quotas are met, ex-vessel prices are effectively reduced to zero.

In summary, the theoretical components which determine capacity and the extent of capacity utilization are the factors affecting individual firm cost structures such as input prices and catch per unit of effort, prices throughout the market system, prices and quantities of substitute products, and input constraints. This total or systems approach to considering capacity and its utilization is not inconsistent with empirical measures of capacity employed by economists interested in questions of capacity of total segments within the economy or the total economy. For example, full capacity has been defined as the "full" input point on an aggregate production function or as a bottleneck point in a general equilibrium system (Klein and Long). Preoccupation with measures for individual industries or production or market levels within a system, considered separately from others at the same time, may overstate the capacity of the system as a whole. Furthermore, consideration of capacity and its utilization is consistent with the requirement of the FCMA which requires both specification and assessment of capacity and its utilization throughout the total system.

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[1] In fact, prices may be used in an alternative definition of economic capacity. In the short run, optimum economic capacity may refer to the level of output where price equals marginal cost and profits are maximized.

Methodological and Measurement Problems in Assessing Capacity and Capacity Utilization

Empirical estimates of capacity and its utilization are extremely difficult to make for any industry because of insufficient basic research, insufficient required data, and inconsistent reporting procedures. These basic needs also affect estimates of capacity for fisheries. Rather than review the general problem areas, the following discussion is limited mainly to a brief review of problems somewhat specific or limited to analysis of economic capacity in U.S. fisheries.

In estimating optimum capacity and capacity utilization in fisheries, the economist operates under one additional constraint compared to many other areas of applied economics. The fisherman, in most cases is harvesting from a relatively fixed pool of resources which are common property. Cultivation of fishery products is presently rather limited. As a point of contrast, agriculture has been able to reduce this fixed resource constraint through development of improved seed varieties, augmentation of the soil's natural nutrient content, etc. Stock limitations in the natural environment place limits on fishery production and the individual fisherman's ability to control production levels. Thus, appropriately, biological variables must be included in estimation procedures. These are recognized in the bioeconomic or equilibrium-yield models. Unfortunately, empirical estimates of biological parameters are nearly as scarce as estimates of some economic parameters.

The fact that many fisheries are defined by type of gear rather than specific species makes multiple-species fisheries a common characteristic of many U.S. fisheries. What may be optimum capacity for one species may be over or under capacity for other species. Two examples are the Tropical Pacific tuna fishery and the Gulf of Mexico reef fish fishery. In the tuna fishery, the yellowfin tuna is fully exploited but the skipjack tuna, which is caught jointly with the yellowfin, is fished at less than optimal capacity (Flagg). In the Gulf of Mexico, preliminary estimates show the red snapper to be fully exploited but the jointly caught grouper to be fished at less than optimum capacity. In these cases, optimum capacity to fish one species will be excess capacity for the other jointly caught species. Recently a linear programming approach has been offered as a means for predicting fleet capacity for a multiple-species fishery (Siegel).

A similar capacity estimation problem occurs when the same fleet fishes several species, not concurrently, but at different times or seasons of the year. An example is provided by the same fleet fishing for stone crab, spiny lobster, and king mackerel in Florida during different seasons of the year. Optimum capacity in terms of vessel size may be different for each individual species. When the fleet is participating in the lobster fishery, there may be excess capacity in terms of an economically efficient size of vessel and/or total fleet size but optimum capacity when fishing for king mackerel.

The seasonal nature of production raises other problems related to capacity in the processing and marketing sectors. Storage, processing, and onshore holding capacity may limit or prevent the harvesting sector from fully utilizing its capacity during peak production seasons. Placing limits on volume of catch is not uncommon in U.S. fisheries during peak production seasons for a given species or during the peak season for another more valuable species processed in the same plant. In spite of the seasonal capacity constraints during seasonal peaks there is considerable overcapacity in the U.S. seafood-processing industry. A review of trends through peaks of quarterly production data shows some processing industry segments operating at between 50% to 80% of annual capacity (Vondruska). Studies of the shrimp-processing industry conclude the industry is operating at considerably less than full capacity in spite of substantial imports of foreign caught shrimp for processing (Prochaska and Andrew). Thus, the question of capacity in the processing sector is important. In some cases, undercapacity during peak production seasons limits the harvesting sector but during other seasons or for other seafood processors there appears to be considerable overcapacity. Related problems arise in the processing of species where year-to-year, rather than seasonal, production cycles exist. During the "off years" excess capacity exists but profits earned from being able to handle the good years may more than offset the apparent inefficiencies in the "off years." Salmon canning plants in Alaska provide an example of this situation.

Currently, the question of joint ventures is of particular concern because of excess U.S. processing capacity. The Secretary of Commerce may issue permits allowing foreign vessels to receive U.S.-harvested fish from fishing vessels within the U.S. fishery conservation zone. The applications and activities must meet the requirements of the FCMA (*Federal Register*). This alternative is capable of relieving processing capacity constraints in some cases but could also lead to still more excess capacity in other cases. A careful evaluation of each application will be required.

Economies of scale in management, advertising, physical efficiency, warehousing and storage, transportation, state and local taxation, financing, and in other areas in addition to volumes produced by fishermen must be considered to analyze fully and evaluate the question of capacity in the processing industry. Because of these factors affecting economies of scale and capacity, there probably is no one optimum size plant. This, of course, is a common phenomenon in many industries (Stigler). Recent research has shown two sizes of shrimp-processing firms to be of optimum size (Alvarez et al.). Thus, in assessing and specifying capacity in U.S. fisheries, the simple approach of projecting total capacity as a product of number of firms and the output of the "average" or optimum firm may not be appropriate.

Estimates of capacity and capacity utilization will be particularly troublesome for fishery management plans for presently under-utilized species. Difficulties in estimating capacity may occur in the harvesting, processing, and marketing sectors. To harvest these species, new types of vessels and gear may be required. Estimates of needed vessel and gear capacity to harvest an optimum yield may be almost speculative. Markets, prices, and types of products probably will not be fully known. Without this information, the number of processing plants and their capacity will be difficult to estimate. Considerable research and experimentation will be required before acceptable estimates of capacity and capacity utilization are forthcoming for undeveloped fisheries.

Capacity Estimates in Initial Fishery Management Plans

The conceptual and methodological issues discussed above make it apparent that the job of estimating capacity and rate of utilization by the industry and support personnel will be difficult. Nevertheless, the FCMA requires these questions be addressed, based on the best available scientific information. Basic research concerning capacity at the processing level has been extremely limited. The question of optimum capacity in the harvesting sector has been often addressed theoretically. Empirical analyses have been done to a lesser extent. Much of the basic research performed prior to the 1976 FCMA has had little or no direct impact on the limited number of management plans developed at the time of the writing of this paper. This is probably so for several reasons. Species composition of fisheries studied may not correspond directly to management units chosen by the respective councils. The geographic area covered by the study may not coincide with areas designated as specific management areas. Rather than review this basic research, the remainder of this paper is devoted to a review of capacity estimates in a sample of fishery management plans developed in the first year of Council activities.

Hold capacity appears to be the most frequently used basic measure for vessel capacity. Estimates of hold capacity in the fishery are made from either a survey of participating vessels, registration and documentation information, or a combination of the two. Adjustments are made (usually assumed) for a percentage of hold capacity actually used or filled on any one trip. This adjusted average trip capacity is then multiplied by number of trips made per year. Once these components are estimated, it is a simple matter to project total physical capacity and expected use of capacity. Other plans simply project capacity (volume produced) based on historic trends or catch per unit of effort models where effort is measured as number of fishermen, gear units, or some other input measure. These estimates do not specifically address the question of optimum economic capacity. They are based on present or historical levels of capacity which may be assumed to be optimum if the system were in a competitive equilibrium. This optimum capacity situation is highly unlikely because of the rarity of an equilibrium situation and also because of the lack of private property rights in fisheries.

Several of the preliminary plans have gone beyond estimating capacity exclusively in the harvesting sector and have considered other factors discussed in this paper. In the Northwest Atlantic Herring Fishery Plan, specific effort was made to relate capacity to expected favorable dockside prices. Favorable prices were based on expected high import prices and the entry of new processors into the industry (due to expected favorable export markets). Also considered in their estimates was added harvesting capacity which was projected to come from related fisheries where effort will be limited through fishery management plans.

The Gulf of Alaska Ground Fish Plan specifically considers capacity in terms of "total capacity." Total capacity was defined to be the sum of harvesting, freezing, and onshore holding capacity. Harvesting capacity was estimated using vessel hold capacity as a base with adjustments similar to those discussed above. Capacity estimated at the other levels in the system were based on interviews. Daily processing and handling rates were estimated with consideration of seasonal variation in production by the harvesting sector. Also considered were capacity limitations due to processors desiring to process more valuable species during particular seasons of the year. Onshore holding capacity appeared to be the most limiting factor in terms of physical capacity, while a lack of an adequate supply of labor was a constraint on capacity utilization in some levels of the processing industry.

In addition to physical hold capacity, abundance and availability of fish were considered as specific determinants of capacity in the Northern Anchovy Fishery Plan. However, processing capacity was concluded to be the limiting factor preventing full utilization of harvesting capacity in this fishery. A dual approach was taken in determining processing capacity. "Nominal" capacity was based on engineering and design characteristics of a plant. The second estimate was based on the "performance of the plant." This estimate considered business and economic decisions as well as physical conditions of the plant. The latter approach provided the lower, but the more realistic estimate of processing capacity. During the peak harvesting season nightly quotas were placed on the fleet.

Other management plans available for review were considerably less sophisticated in approach to the estimate of capacity. This was often due to a lack of basic information. For example, the Caribbean Spiny Lobster Plan simply noted the market did not appear to be a limiting factor because of sizeable imports of spiny lobsters and a local preference for nonprocessed lobster products. Harvesting capacity was based on catch per unit of effort and projected effort. The distinction between capacity and rate of capacity utilization is often not made in management plans. Projections are, in fact, predicted supply responses and in some cases, simply measures of physical capacity.

Summary and Conclusions

Capacity and capacity utilization are required considerations for determining expected domestic annual harvest by U.S. fishermen and level of allowable foreign catch. Conceptually, the broad systems approach to defining capacity and rate or level of capacity utilization seems theoretically appropriate and is consistent with requirements of the FCMA. Capacity and the level of capacity utilization depend on input prices, physical productivity, and activities and constraints in the market and processing sectors which are transmitted to the harvesting sector through the pricing system. Methodologically and empirically there are many obstacles to complete analysis of the required questions of capacity. Some of the most important problems in estimation are related to a lack of basic research and data, complexities of multiple-species fisheries, seasonality of production, and unknowns in the production, processing, and marketing of under-utilized species. Several of the presently proposed plans do a commendable job of considering economic factors throughout the system. The question of optimum economic capacity is addressed to a lesser extent. Although it may always be impossible to address completely the question of capacity and capacity utilization, these conceptual considerations are of importance because the suggestion of data and research needs is a specific requirement of fishery management plans. Refinements in data collection and additional basic research will allow future and revised plans to more completely estimate capacity and its utilization.

Distinction should be made between capacity and rate or level of capacity utilization in development of fishery management plans. Capacity at any one point in time is basically the physical level of output a firm or the industry is capable of producing with existing plant and equipment. Capacity is based on long-run considerations of expected prices and costs. There is little flexibility in plant and equipment size within production periods, especially in the processing sector. Rate at which capacity is utilized is, however, more flexible and can be changed in response to short-run changes in price, costs, and other conditions. Immediate or year-to-year allocation decisions concerning domestic and foreign catch allocations need to consider rate-of-capacity utilization while longer term planning must also consider additions or reductions in physical capacity of the industry. These distinctions are consistent with the FCMA which requires an assessment of (*a*) capacity and (*b*) the extent it will be utilized.

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Seafood Processing Capacity in Commercial Fisheries Management: Discussion

Nancy Bockstael

Prochaska has been asked to deal with a most ambiguous and confusing economic concept in the context of one of the most complex of industry environments. In the space and time allotted, he has touched on a wide range of important issues and a number of interpretations of capacity. If I have a major disagreement with his paper, it is in terms of focus.

In responding to the Fisheries Conservation and Management Act, the contribution economists have to make is in clearly defining the informational and analytical needs of managers to carry out the bill's spirit and intent, rather than exercising "blind" compliance with the language. If we are not careful to do this at the outset, we shall find ourselves pursuing irrelevant analysis and endless data searches.

I make this point, because I advocate sidestepping the issue of actually measuring capacity. Consider that much quoted passage from PL 94–265: "Any fishery management plan . . . shall assess and specify the capacity and the extent to which fishing vessels of the United States, on an annual basis, will harvest the optimum yield." It is the amount of the total allowable catch of each species which U.S. firms "will harvest" that is in question. Consequently, economists should focus on predicting short- and long-run supply response by relating them to observable economic and individual sociological variables rather than on trying to measure and add up capacity figures. By supply response, I refer to utilization of existing capital: decisions regarding number of days spent fishing and allocation of those days among alternative species or fisheries. I also refer to changes in the size and number of vessels owned by firms and exit and entry of firms in fisheries.

It would seem that Prochaska and I are in agreement conceptually if not in terminology. He argues that physical capacity measures, at least in the harvesting sector, are not very useful. I agree, since fishermen depend on finite biological stocks, face no restrictions on entry at present, and are free to transfer vessels between fisheries. In this milieu, physical capacity (maximum hold capacity times maximum number of trips, summed for all vessels) can never be expected to be a binding constraint. Additionally, Prochaska acknowledges the importance of understanding changes in capacity rather than simply counting it and recognizes that market conditions are important in determining optimum levels of capacity and capacity utilization for the firm. Surely this sounds like a conceptual approach consistent with long- and short-run supply response.

In the final sections of the paper, however, Prochaska discusses "optimum" capacity and capacity utilization in a different context. The discussion is not at all consistent with the supply-response concept. The use of the term "optimum" in the different sections of the paper is confusing, but the distinction between its two uses and the choice between them must be made carefully for economists to focus on the correct informational and analytical requirements.

Clearly, if economists are going to have anything to say about the behavior of economic agents, we must assume that they are rational profit maximizers, given their time preference and institutional and informational constraints. However, a firm's optimal behavior can be expected to differ from the optimum prescribed by economically efficient resource management for a number of reasons. The most obvious source of this divergence is the problem associated with the absence of property rights in the fishery. Other sources are the differences in time preference, as well as risk aversion, which are likely to exist between

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individual fishermen and society (as reflected by the management authority). Additionally, fishermen's expectations may be based on different informational sources than manager's plans.

An important question which the Prochaska paper implicitly raises is the following: Should we be initiating efforts in the direction of calculating optimum capacity and capacity utilization for fisheries or should we be attempting to model fishing firms' investment and shorter-run supply response to different market and regulatory environments? Considering that we do not now, nor are we likely to in the near future, have complete economic control of the industry, I would argue for addressing our attention to modeling behavior. Optimum regulatory schemes can better be determined with knowledge of firms' expected responses.

It seems that this approach has the added advantage of depending less heavily on precise biological assessment data. Fishermen's decisions cannot depend on perfect knowledge of the fish stocks, but are more likely based on expectations formed from past observations on catch per day fished. If we can approximate their formation of expectations, we can predict their responses on the basis of existing observable data. The effect of fishermen's responses on the stocks still requires biological assessment. However, the supply response approach would seem to place a smaller burden on the biological analysis and would prevent the economist's contribution from becoming inextricably dependent on stock assessment, a danger which Prochaska and many others of us have feared would delay the formation of good management plans. In recognition of some of these advantages, the New England Management Council staff (in Res. Doc. 78 G.F5.1) recently has indicated an intent to initiate research in the directions which are proposed here.

References

Public Law 94–265. *Fishery Conservation and Management Act of 1976*, Section 303 (a4).

New England Management Council. Research Doctrine 78 G F51, Subject: *Economics and Biological Analysis Inputs to Groundfish FMP*, 15 May 1978.

Seafood Processing Capacity in Commercial Fisheries Management: Discussion

Frank Orth

Fred Prochaska's paper is thorough and well organized. He correctly stresses that (*a*) capacity and the utilization rate are partially price determined, (*b*) species substitution in harvesting and processing is frequently encountered and necessary to incorporate formally into capacity analysis and (*c*) conceptualization, estimation techniques, and data requirements are all worthy of more research.

My time and space allocation will be devoted to discussing the requirements for processing capacity estimates for management decisions. Most of the points I will make appear to be consistent with Prochaska's views on processing capacity and capacity utilization.

On the theoretical level, once a given scale of plant is defined there is, in general, a unique level of output which is capacity; it is that level where short-run average cost is tangent to long-run average cost. A different level of output, one which is expected by managers to be maintained, would induce an increase or decrease in scale and thereby cause capacity to change.

In the meantime, however, the actual level of output might be much different than the capacity output as just defined. For this reason, the theoretical definition is not very helpful as an operational guide for short-run capacity estimation, especially when one considers the very real possibility of input indivisibility and high output variability (due to input variation or demand constraints). Both of these factors could lead management to accept output levels over a wide range without considering investment to change capacity.

In the enacted version of the Fisheries Conservation and Management Act, 1976 (FCMA), estimates of processing capacity were not explicitly required. Two situations have made domestic processing capacity relevant, however. First, in a fishery where joint ventures between domestic harvesters and foreign processors are not allowed, or where no applicants for joint ventures have appeared, domestic processing capacity may be an important constraint on the full utilization of domestic harvesting capacity and therefore on the domestic allocation.

The second situation exists when domestic and foreign markets for a species interact or compete in some significant way. A large foreign allocation may lead to adverse price effects in markets supplied in part by U.S. processors; price reduction might, in turn, induce significant underutilization of domestic harvesting capacity. In short, an "economic factor" for determining optimum yield may be perceived to exist and processing capacity estimates may then become useful in establishing this case, particularly when processing capacity is perceived as being the limiting sector of the vertical chain.

If, as appears likely, the Federal Commercial Fisheries Act (FCMA) is amended to require that explicit account be taken of domestic processing capacity in fishery management plans, the development of methods for baseline assessment and annual updating will be required. The leading candidate methods are the "peak-to-peak" or "trend-through-peaks" method and periodic survey of processors. The peak-to-peak method requires adjustment for application to detailed industries; that is, to species and process form. Industrywide capacity (usually measured within a specific geographic region) for a species and/or process form is determined from the peaks in the sum of individual plant production for that species or process form within the region. Utilization rates are then determined by comparing actual production with the trend line.

One problem with the trend-through-peaks technique is the inability to distinguish true capacity peaks from biological peaks that do

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not actually stress capacity. One study is examining ex-vessel price movements to distinguish such peaks from true capacity peaks (Georgianna et al.). Another problem occurs with the application of this technique in a developing fishery. Major changes in actual capacity can occur ahead of the lag in availability of production data, in which case estimating capacity from a trend derived from the latest measured peaks in production can cause serious understatement of actual capacity and overstatement of utilization. On the other hand, there is some potential for miscalculation of processing capacity for an individual species in cases where there exists a high degree of species substitution in production and where the peak is established during an abnormal period when one species was unusually plentiful and another scarce. Total capacity for the plentiful species might be significantly less in a more "normal" period, and obversely. In some situations, therefore, aggregation of individual plant production by technically substitutable species within a process form may be more meaningful than by species. Relative cost and price analysis for relevant species would then be required in order to obtain species-specific capacity estimates. Despite these difficulties, there does appear to be sufficient promise with the trend-through-peaks approach that further work on methods, and on evaluation of ways to improve the quality and timing of data would be appropriate.

The survey method is particularly appealing when structural change is occurring, as in developing fisheries. A uniform definition of capacity is essential for survey results to be meaningful in their own right and for comparability between studies. The potential for significant overstatement of total industry capacity exists with this method as individual plant responses are aggregated. A generalized method of identifying and correcting for this bias can probably be developed through research.

Research to develop a uniform definition of capacity for survey respondents, which is oriented to the realities of the seafood-processing sector and sufficiently general to have broad application over species and process forms, should be a high priority of fisheries management agencies. A consistent definitional framework is a logical antecedent to the identification of data needs for management as specified in the FCMA [Sec. 303 (a)(5)].

Reference

Georgianna, Daniel, Peter Greenwood, Richard Ikara, and Richard Ward. *A Method of Estimating Fish Processing Capacity in Massachusetts and New Hampshire*. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, South Massachusetts University Foundation.

Implications of Regional Agricultural Policies in Canada
(George Brinkman, University of Guelph, Chairperson)

The Regional Consequences of the Canadian Tariff Structure

Tim Hazledine

The work reported in this paper is drawn from a larger study being undertaken by the author for the Economic Council of Canada under the rubric "The Costs and Benefits of the Canadian Federal Customs Union." In considering some conceivable alternatives to the present federal system, my focus is limited to predicting their implications for production and trade through changes in the commercial relations (tariff structure) among the regions and with the rest of the world. Within such an approach, the relatively mild form of separation that would retain monetary union and free interregional trade has no effect.

The empirical base for this study is a set of data assembled for the year 1974 giving industrially disaggregated production, consumption, and trade flows for each of five regions of Canada (Atlantic, Quebec, Ontario, Prairies, British Columbia). On this data base is built a simple model in which changes in economic flows are functions of changes in tariffs, wage rates, and exchange rates. The model is used to calculate, for a given change in a region's commercial policy, the adjustments in wages and exchange rates needed to maintain employment and the balance of trade at given levels.

For reasons of space we consider only one alternative (Option 1) to the present federal system. In Option 1, it is assumed that each region retains the present Canadian tariff structure and imposes it on the other regions. While not in itself a very likely event, Option 1 does allow us to assess how regional patterns of economic activity are affected by the Canadian customs union.

In this paper we will examine production and employment effects, but not consumption changes, so that no assessment will be made of the economic welfare consequences of Canada for its constituent regions.

Changes in Production, Shipments, and Employment

We disaggregate each region's shipment flows for each industry into five categories: S_D is domestic shipments (goods produced and consumed within the region); S_{RX} is regional exports (goods produced within the region and shipped to other Canadian regions); S_{WX} is foreign exports (within-region production shipped to other countries); S_{RM} is regional imports (shipped into the region from other regions); S_{WM} is foreign imports (shipped into the region from other countries).

Shipments in each of the domestic categories (S_D, S_{RM}, S_{WM}) are determined by demand, which is a function for each category of the prices of all three. Making use of the definition of elasticity of Y with respect to a change in X, $\epsilon_Y{}^X$, we have

$$(1) \qquad \dot{Y} = \frac{dY}{Y} = \epsilon_Y{}^X \dot{X},$$

where the 'dot' superscript denotes a variable in rate of change form. The formulas for changes in each of the domestic shipment flows (at base period prices) are:

$$(2) \qquad \dot{S}_D = \epsilon_{SD}{}^P \dot{P}_D + \epsilon_{SD,RM}{}^D \dot{P}_{RM} + \epsilon_{SD,WM}{}^P \dot{P}_{WM},$$

$$(3) \qquad \dot{S}_{RM} = \epsilon_{SRM}{}^P \dot{P}_{RM} + \epsilon_{RM,D}{}^P \dot{P}_D + \epsilon_{SRM,WM}{}^P \dot{P}_{WM}, \text{ and}$$

$$(4) \qquad \dot{S}_{WM} = \epsilon_{SWM}{}^P \dot{P}_{WM} + \epsilon_{SWM,D}{}^P \dot{P}_D + \epsilon_{SWM,RM}{}^P \dot{P}_{RM},$$

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where, for example, ϵ_{SD}^P is the own-price elasticity of S_D with respect to P_D, and $\epsilon_{SD,RM}^P$ is the cross-price elasticity of S_D with respect to P_{RM}. In these and subsequent equations, we will ignore any inaccuracies (nonlinearities) introduced by using the infinitesimal calculus in situations involving noninfinitesimal changes in variables.

Changes in shipments to other regions—S_{RX}—are more complicated. Under Option 1, the price received by a region's shippers (P_{RX}^S, the 'supply price') will fall as the tariff is imposed on interregional trade. We assume that the price fall wipes out the highest-cost operators according to a 'capacity elasticity' ϵ_{QRX}^P defined as the proportion of base-period shipments produced by the operators who would go out of business for the given price change.

As well, there will be a change in the price paid (P_{RX}^d) in other regions with the imposition of the tariff, which will affect sales of the surviving capacity. Thus, we have

$$(5) \quad \dot{S}_{RX} = \epsilon_{QRX}^P(\dot{P}_{RX}^S - \dot{C}_{RX}) + \epsilon_{SRX}^P \dot{P}_{RX}^d,$$

with $\dot{C}_{RX}$ the proportional change in costs resulting from adjustments to the tariff change. Analogously, for foreign shipments the expression is

$$(6) \quad \dot{S}_{WX} = \epsilon_{QWX}^P(\dot{P}_{WX} - \dot{C}_{WX}) + \epsilon_{SWX}^P \dot{P}_{WX}.$$

Changes in employment are calculated from changes in shipments on the assumption that average employment/shipments ratio of surviving capacity are constant. We have employment elasticity estimates that give employment/shipment ratios for the highest-cost plants, so that the employment effects of any reductions in an industry's capacity can be calculated.

Elasticities and Changes in Prices and Costs

To solve equations (2) to (6) for each industry, we have to specify values for the parameters (elasticities) and explain how changes in the tariff structure and other policy adjustments affect prices and costs.

We have estimates from various sources of Canadian export, import, and domestic consumption price elasticities. It will be assumed that these estimates can be used as regional elasticities (implying, in particular, that $\epsilon_{SD}^P = \epsilon_{SRM}^P = \epsilon_{SRX}^P$). Cross-price elasticities are computed according to a heuristic formula

$$(7) \quad \epsilon_{ij}^P = -\epsilon_j^P S_j/S_i,$$

where S_j and S_i are the shipments of j and i.

Capacity and employment elasticities come from distribution functions fitted by Statistics Canada for the author to data on individual establishments in each industry. Establishments were ranked by the ratio of costs to value of output and functions were fitted to the distribution of costs and of employment against accumulated shipments.

We have assumed that domestic, regional, and foreign sources of supply are differentiated (imperfect substitutes). This rules out the full-pricing-up-to-the-tariff assumption generally found in studies of effective protection and trade patterns. (Note that an implication of full-pricing-up-to-the-tariff is that imposing interregional tariffs would have no effect on prices and thus on regional trade.) In a background study (ECC), I found empirical support for the differentiated product postulate, and estimated a pricing equation which can be expressed as

$$(8) \quad P_D = \frac{P_W}{r}(\theta T + C),$$

where P_D and P_W are the domestic and world prices, r is the exchange rate, θ a markup on the rate of tariff protection, T, and C domestic costs relative to world costs. For the present, with given world prices, no changes in tariff rates (apart from extending their coverage), and in which the only source of cost changes will be wage changes, we can derive

$$(9) \quad \dot{P}_D = -\dot{r} + \alpha \dot{W} \gamma,$$

with α as the share of wages in total costs, W the wage rate, and $\gamma = C/(\theta T + C)$. It was estimated that

$$(10) \quad \theta = 5.135 \times (\text{Herfindahl Index of Concentration}).^1$$

Regional imports are priced the same as domestic shipments in the base period and at the same price as foreign imports under Option 1. Using (8) and

$$(11) \quad P_{WM} = \frac{P_W}{r}(1 + T),$$

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[1] Herfindahl Index = $\Sigma(Si/S)^2$, where Si/S is the share of firm i ($i = 1, \ldots, n$) in the total shipments of its industry.

we can obtain

$$(12)\qquad \dot{P}_{RM} = \frac{(1+T)}{(\theta T + C)}(1-\dot{r}) - 1,$$

approximating $1/(1+\dot{r})$ by $(1-\dot{r})$, and given that

$$(13)\qquad \dot{P}_{WM} = -\dot{r}(=\dot{P}_{WX}).$$

The price paid for regional shipments, $P_{RX}{}^{d}$, changes from the domestic to the world price plus the tariff, so that

$$(14)\qquad \dot{P}_{RX}{}^{d} = \frac{(1+T)}{(\theta T + C)} - 1.$$

The price received, $P_{RX}{}^{s}$, changes from the domestic to the foreign export price, P_{WX}, in domestic currency, and

$$(15)\qquad \dot{P}_{RX}{}^{S} = \frac{(1-\dot{r})}{(\theta T + C)} - 1.$$

The only source of cost change considered is changes in wage rates, which affect all shipments; we assume equally. Thus,

$$(16)\qquad \dot{C}_{D} = \dot{C}_{RX} = \dot{C}_{WX} = \alpha \dot{W}$$

where α is the share wages are of total costs, and $\dot{W}$ is the rate of change of the wage rate.

Policy Target Equations

The two policy targets considered are the balance of external (regional and foreign) trade and the level of employment. We will see that the previous section's equations imply equations for each of these targets that are linear functions of the region's exchange rate and wage level—two policy instruments. Thus, the equations can be rearranged simply, to show the levels at which the two instruments must be set to achieve any pair of policy targets.

The balance of trade is defined as

$$(17)\qquad B^{1} = X^{1} - M^{1} + R^{1},$$

where

$$(18)\qquad \begin{aligned} X^{1} = {} & (1 + \dot{P}_{WX} + \dot{S}_{WX})S_{WX}{}^{0} \\ & + (1 + \dot{P}_{RX}{}^{S} + \dot{S}_{RX})S_{RX}{}^{0}, \end{aligned}$$

$$(19)\qquad \begin{aligned} M^{1} = {} & (1 + \dot{P}_{WM} + \dot{S}_{WM})S_{WM}{}^{0} \\ & + (1 + \dot{P}_{RM} + \dot{S}_{RM})S_{RM}{}^{0}, \text{ and} \end{aligned}$$

$$(20)\qquad R^{1} = TM^{1},$$

and T is the tariff rate on imports and the superscripts 0 and 1 refer to before and after separation, respectively. Expanding equation (17),

$$(21)\qquad \begin{aligned} B^{1} = {} & (1 + \dot{P}_{WX} + \epsilon_{QWX}{}^{P}\,[\dot{P}_{WX} - \dot{C}_{WX}] \\ & + \epsilon_{SWX}{}^{P}\,\dot{P}_{WX})S_{WX}{}^{0} + (1 + \dot{P}_{RX}{}^{S} \\ & + \epsilon_{QRX}{}^{P}\,[\dot{P}_{RX} - \dot{C}_{RX}] \\ & + \epsilon_{SRX}{}^{P}\,\dot{P}_{RX})S_{RX}{}^{0} \\ & - (1-T)(1 + \dot{P}_{WM} \\ & + \epsilon_{SWM}{}^{P}\,\dot{P}_{WM} + \epsilon_{SWM,D}{}^{P}\,\dot{P}_{D} \\ & + \epsilon_{SWM,RM}{}^{P}\,\dot{P}_{RM})S_{WM}{}^{0} \\ & - (1-T)(1 + \dot{P}_{RM} + \epsilon_{SRM}{}^{P}\,\dot{P}_{RM} \\ & + \epsilon_{SRM,D}{}^{P}\,\dot{P}_{D} + \epsilon_{SRM,WM}{}^{P}\,\dot{P}_{WM})S_{RM}{}^{0}. \end{aligned}$$

Equation (21) can be rearranged as

$$(22)\qquad \begin{aligned} B^{1} = {} & S_{WX}{}^{0} + S_{RX}{}^{0} - (1-T)S_{WM}{}^{0} \\ & - (1-T)S_{RM}{}^{0} + (1 + \epsilon_{QWX}{}^{P} \\ & + \epsilon_{SWX}{}^{P})\dot{P}_{WX}\,S_{WX}{}^{0} \\ & - \epsilon_{QWX}{}^{P}\,\dot{C}_{WX}\,S_{WX}{}^{0} \\ & + (1 + \epsilon_{QRX}{}^{P})\dot{P}_{RX}{}^{S}\,S_{RX}{}^{0} \\ & + \epsilon_{SRX}{}^{P}\,\dot{P}_{RX}{}^{d}\,S_{RX}{}^{0} - \epsilon_{QRX}{}^{P}\,\dot{C}_{RX}\,S_{RX}{}^{0} \\ & - (1-T)(S_{WM}{}^{0} + \epsilon_{SWM}{}^{P}S_{WM}{}^{0} \\ & + \epsilon_{SRM,WM}{}^{P}\,S_{RM}{}^{0})\dot{P}_{WM} \\ & - (1-T)(\epsilon_{SWM,D}{}^{P}\,S_{WM}{}^{0} \\ & + \epsilon_{SRM,D}{}^{P}\,S_{RM}{}^{0})\dot{P}_{D} - (1-T)(S_{RM}{}^{0} \\ & + \epsilon_{SRM}{}^{P}\,S_{RM}{}^{0} + \epsilon_{SWM,RM}{}^{P}\,S_{WM}{}^{0})\dot{P}_{RM} \\ = {} & a_{0} + a_{1}\dot{P}_{WX} - a_{2}\dot{C}_{WX} + a_{3}\dot{P}_{RX}{}^{S} \\ & + a_{4}\dot{P}_{RX}{}^{d} - a_{5}\dot{C}_{RX} \\ & - a_{6}\dot{P}_{WM} - a_{7}\dot{P}_{D} - a_{8}\dot{P}_{RM}, \end{aligned}$$

where the a's are the coefficients of each of the price and cost change variables.

Making use of the expressions for the P's and C's developed in the previous Section, we can further refine equation (22)

$$(23)\qquad \begin{aligned} B^{1} = {} & a_{0} - a_{1}\dot{r} - a_{2}\alpha\dot{W} \\ & + a_{3}\left\{\frac{(1+\dot{r})}{\theta T + C} - 1\right\} \\ & + a_{4}\left\{\frac{1+T}{\theta T + C} - 1\right\} - a_{5}\alpha\dot{W} \\ & - a_{6}\dot{r} - a_{7}(\alpha\dot{W}\gamma - \dot{r}) \\ & - a_{8}\left\{\frac{1+T}{\theta T + C}(1-\dot{r}) - 1\right\} \\ = {} & a_{0} + \frac{a_{3}}{\theta T + C} \\ & - a_{3} + \frac{a_{4}(1+T)}{\theta T + C} \\ & - a_{4} - \frac{a_{8}(1+T)}{\theta T + C} + a_{8} \\ & - (a_{2}\alpha + a_{5}\alpha + a_{7}\alpha\gamma)\dot{W} \\ & - \Bigg(a_{1} + \frac{a_{3}}{\theta T + C} \end{aligned}$$

$$+ a_6 - a_7 - \frac{\alpha_8(1 + T)}{\theta T + C}\Bigg) \dot{r}.$$

For the change in employment, ΔE, we have

$$\Delta E = \Delta E_D + \Delta E_{WX} + \Delta E_{RX}. \tag{24}$$

Assuming that each plant can expand output at a constant marginal cost gives

$$\Delta E_D = \dot{S}_D \cdot E_D{}^0, \text{ and} \tag{25}$$

$$\Delta E_{WX} = \dot{S}_{WX} \cdot E_{WX}{}^0. \tag{26}$$

For regional exports there will be a loss in high-cost capacity. We have an estimate of the (total) employment elasticity with respect to changes in (total) capacity at the high-cost margin, $\epsilon_E{}^Q$, and we will assume that this elasticity holds for the portion of capacity involved in interregional shipments. Then

$$\begin{aligned} \Delta E_{RX} &= \epsilon_E{}^Q\, \dot{Q}_{RX}\, E_{RX}{}^0 + \epsilon_{SRX}{}^P\, \dot{P}_{RX}{}^d\delta \\ &= \epsilon_E{}^Q \epsilon_{QRX}{}^P(\dot{P}_{RX}{}^S - \dot{C}_{RX})E_{RX}{}^0 \\ &\qquad + \epsilon_{SRX}{}^P\, \dot{P}_{RX}{}^d\delta, \end{aligned} \tag{27}$$

by making use of equation (5); where

$$\delta = E_{RX}{}^0(1 + \epsilon_E{}^Q\, \dot{Q}_{RX}), \tag{28}$$

that is, the base-period employment in the capacity that survives imposition of the interregional tariff. The total change in employment is thus found by summing (25), (26), and (27).

From (2) and (6) it follows that

$$\begin{aligned} \Delta E = {} & (\epsilon_{SD}{}^P\, P_D + \epsilon_{SD,RM}{}^P\, \dot{P}_{RM} \\ & + \epsilon_{SD,WM}{}^D\, \dot{P}_{WM})E_D{}^0 + \epsilon_{QWX}{}^P(\dot{P}_{WX} \\ & - \dot{C}_{WX})E_{WX}{}^0 + \epsilon_{SWX}{}^P\, \dot{P}_{WX}\, E_{WX}{}^0 \\ & + \epsilon_E{}^Q\, \epsilon_{QRX}{}^P(\dot{P}_{RX}{}^S - \dot{C}_{RX})E_{RX}{}^0 \\ & + \epsilon_{SRX}{}^P\, \dot{P}_{RX}{}^d[1 + \epsilon_E{}^Q\, \epsilon_{QRX}{}^P(\dot{P}_{RX}{}^S \\ & - \dot{C}_{RX})]E_{RX}{}^0 = b_1\dot{P}_D + b_2\dot{P}_{RM} \\ & + b_3\dot{P}_{WM} + b_4\dot{P}_{WX} - b_5\dot{C}_{WX} \\ & + b_6\dot{P}_{RX}{}^S - b_7\dot{C}_{RX} + b_8\dot{P}_{RX}{}^d. \end{aligned} \tag{29}$$

Making use of the expressions in the previous section,

Table 1. Quebec Results, Model 1.1 ($000) (No Policy Adjustments)

	Percentage Change in Regional Shipments Capacity	Percentage Change in Regional Shipments	Net Extra-Regional Shipments, 1974	Net Extra-Regional Shipments, Option 1	Employment 1974	Employment Option 1
1	.0	.0	−618434	−618434	112000	112000
2	.0	.0	−235526	−235526	16115	16115
3	.0	.0	−51923	−51923	2400	2400
4	.0	.0	−793601	−793601	72	72
5	.0	.0	672628	672628	25139	25139
6	−.03	−.05	−15714	−100894	56480	56840
7	−.30	−.26	72183	−20194	5818	4381
8	−.02	−.05	−212485	−231956	13822	13597
9	−.04	−.12	56625	31290	12564	11904
10	−.07	−.09	277327	192558	39044	37578
11	−.03	−.12	136455	110007	16026	15349
12	−.01	−.09	615941	549359	67139	64520
13	−.05	−.03	90476	82079	24771	24698
14	−.01	−.10	114217	86796	20051	19285
15	−.01	−.03	1254543	1224858	45367	45036
16	−.01	−.05	70132	58011	25289	25034
17	−.03	−.02	883202	831546	30267	30032
18	−.02	−.06	−184106	−237313	39161	38634
19	−.00	−.02	−1093355	−1101373	17487	17446
20	−.01	−.01	−2639655	−2643911	30006	29949
21	−.05	−.07	−463995	−548045	33692	32498
22	−.03	−.04	−9185	−18145	15545	15441
23	−.11	−.12	333921	268005	3254	3171
24	−.02	−.04	120501	71254	26779	26446
25	−.04	−.06	−348753	−383242	18578	17989
26	.0	.0	−351211	−351211	0	0
27	.0	.0	−163868	−163868	47383	47383
28	.0	.0	303003	303003	1682391	1682391

Note: Total net exports, 1974 = −2180747 ($000); total net exports, option 1 = −3018242 ($000); total employment, 1974 = 2427000; total employment, option 1 = 2414936.

$$
\begin{aligned}
(30)\quad \Delta E = {} & - b_1 r + b_1 \alpha W \gamma \\
& + b_2 \left\{ \frac{(1 + T)}{\theta T + C} (1 - r) - 1 \right\} \\
& - b_3 r - b_4 \dot{r} - b_5 \alpha \dot{W} \\
& + b_6 \left\{ \frac{(1 - \dot{r})}{\theta T + C} - 1 \right\} \\
& - b_7 \alpha \dot{W} + b_8 \left\{ \frac{(1 + T)}{(\theta T + C)} - 1 \right\} \\
= {} & (b_7 + b_2) \frac{(1 + T)}{(\theta T + C)} \\
& + \frac{b_6}{\theta T + C} - b_2 - b_6 - b_8 \\
& + (b_1 \alpha \gamma - b_5 \alpha - b_7 \alpha) \dot{W} \\
& + \left(- \frac{b_2 (1 + T)}{(\theta T + C)} \right. \\
& \left. - \frac{b_6}{\theta T + C} - b_3 - b_4 \right) \dot{r}.
\end{aligned}
$$

Equations (23) and (30) will be calculated for each industry, then aggregated to give regional aggregate balance of trade and change in employment equations.

Solving the Policy Equations

The model is solved using 1974 data with each region's economy disaggregated into twenty-eight sectors (listed in the appendix). For space reasons, only results for Quebec are shown in this paper. Results for other regions are available on request.

Table 1 shows the effects of imposing interregional tariffs, with no change in Quebec's exchange rate or money wage. The effect is to increase the deficit on total extraregional shipments by nearly 40% and to reduce employment slightly. The main reason for these changes is the fall in shipments to other regions of Canada.

Next, consider possible policy adjustments. Equations (23) and (30) computed for each

Table 2. Quebec Results, Model 1.1 ($000) (After 10% Devaluation, 5% Cut in Money Wage Rate)

	Percentage Change in Regional Shipments Capacity	Percentage Change in Regional Shipments	Net Extra-Regional Shipments, 1974	Net Extra-Regional Shipments, Option 1	Employment 1974	Employment Option 1
1	.09	.09	−618434	−649356	112000	112000
2	.08	.08	−235526	−247302	16115	16115
3	.10	.12	−51923	−54519	2400	2400
4	.07	.07	−793601	−833281	72	72
5	.09	.09	672628	724001	25139	24776
6	.10	.09	−15714	48266	56840	56770
7	−.17	−.14	72183	13119	5818	5003
8	.09	.06	−212485	−226664	13822	14476
9	.06	−.02	56625	50781	12564	12520
10	.04	.02	277327	284092	39044	38524
11	.10	.01	136455	146995	16026	15749
12	.11	.03	615941	688419	67139	66283
13	.07	.05	90476	99991	24771	24573
14	.07	−.02	114127	113540	20051	19660
15	.07	.05	1254543	1411511	45367	45273
16	.07	.03	70132	75152	25289	24484
17	.04	.05	883202	980036	30267	30587
18	.09	.05	−184106	−210621	39161	39708
19	.09	.08	−1093355	−1125710	17487	18385
20	.10	.10	−2639655	−2699929	30006	31686
21	.06	.04	−463995	−501321	33692	35290
22	.07	.06	−9185	−8870	15545	15235
23	.05	.05	333921	364037	3245	3133
24	.07	.05	120501	153455	26779	27289
25	.07	.05	−348753	−371193	18578	19563
26	.07	.07	−351211	−386332	0	0
27	.0	.0	−163868	−163868	47383	47383
28	.09	.09	303003	375655	1682391	1686422

industry and aggregated across all industries, are

$$(31)\quad B^1 = -1.974 \times 10^6 - 3.158 \times 10^6 \dot{W} - 1.680 \times 10^7 \dot{r}, \text{ and}$$

$$(32)\quad \Delta E = -1.157 \times 10^4 - 1.212 \times 10^5 \dot{W} - 3.320 \times 10^5 \dot{r}.$$

These equations can be rearranged to get the policy instruments $\dot{W}$ and $\dot{r}$ as functions of the targets B^1 and E, i.e.,

$$(33)\quad \dot{r} = -0.179 - 1.228 \times 10^7 B^1 + 3.197 \times 10^{-6} \Delta E, \text{ and}$$

$$(34)\quad \dot{W} = 0.337 + 3.366 \times 10^{-7} B^1 - 1.401 \times 10^{-5} \Delta E.$$

On the basis of equations (33) and (34), a target of no-change from 1974 (i.e., $B^1 = -1.14 \times 10^6$, $\Delta E = 0$)[2] could be achieved by a devaluation of Quebec's currency of 3.9%, coupled with a cut of 4.7% in money wages.

To eliminate completely the imbalance of payments while maintaining 1974 employment levels would require much larger adjustments—a devaluation of 17.9% and money wage increases of 33.7%. This money wage increase, by increasing the relative price of nontraded goods, mainly services, which are not affected by world prices, reduces the demand for them and so frees labor to be employed in the export- and import-substituting sectors. This suggests relaxing the 1974 employment constraint. With no changes in money wages, a zero balance of payments could be attained through a devaluation of 11.8%, with employment rising by 27,440. Table 2 shows, industry-by-industry, what happens when a mixed policy—10% devaluation and 5% wage cut—is followed. This results in a fall in the total payments deficit to $136 million, and an increase in employment of 27,750.

There is not space to analyze these results in any detail. As a final caveat, it should be noted that both the data base and the model are still subject to correction and modifications. As well, it may be repeated that no measurement is made here of the changes in economic welfare associated with the various options and policies. This will be attempted in subsequent work.

Appendix

List of Industries

1. Agriculture
2. Forestry
3. Fishing
4. Petroleum and natural gas
5. Other inedible crude materials
6. Food and beverage manufacturing
7. Tobacco and products industries
8. Rubber and plastic products
9. Leather products
10. Textiles
11. Knitting mills
12. Clothing
13. Wood industries
14. Furniture and fixtures
15. Paper and allied
16. Printing, publishing, and allied
17. Primary metals
18. Metal fabricating
19. Machinery
20. Transportation equipment
21. Electrical products
22. Nonmetallic mineral products
23. Petroleum and coal products
24. Chemicals and products
25. Miscellaneous manufacturing
26. Residual manufacturing industries (none in Quebec)
27. Construction
28. All other industries

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[2] The figure of $1.14 billion for the 1974 Quebec deficit on trade was arrived at by adding to net exports the duty paid on the foreign imports.

The Regional Consequences of the Canadian Tariff Structure: Discussion

Robert L. Thompson

In this paper Hazledine makes an important contribution in developing a unified analytical framework to estimate the regional effects of a customs union on production, shipments, and employment in a multisectoral model. We find all too few attempts at empirical, multisectoral, general equilibrium analysis of the effects of changes in trade policy in the literature.[1] Hazledine's study makes a significant addition to this small but important literature.

One particularly interesting and innovative aspect of Hazledine's framework is his treatment of the entry and exit of firms and workers from each sector in response to changes in trade policy. The adjustment costs associated with firms being expelled from a sector represent one of the greatest sources of inertia inhibiting changes in trade policy. Agriculture Canada is certainly interested in the effects of possible changes in the structure of the Canadian customs union on the number of farms and employment in each region's agriculture.

Hazledine's treatment of capital stock adjustment in response to changes in trade policy is extremely simplified. I have some doubts concerning the ability of his entry-exit elasticities to capture the very complex investment-disinvestment processes which lie behind them. Moreover, the opportunity cost and malleability of the existing capital stock varies considerably from sector to sector. Nevertheless, Hazledine's simplification provides an acceptable first approximation which does get at the capital stock adjustment process more than previous studies.

In addition, Hazledine makes an interesting innovation by drawing upon his industrial organization background in introducing domestic markup elasticities into a model for trade policy analysis.

Now, I turn to several quibbles which I would like to raise with respect to Hazledine's paper.

First, there is no income term in the demand equation specification. Demand for each good is specified as a function of only three prices, but not real income. However, real income changes do result from changes in trade policy, such as those treated in this paper. I have some severe reservations about ignoring this important feedback effect.

Second, is there any evidence of differences in the export, import, and domestic consumption price elasticities among the regions of Canada for each product? They are assumed the same here in all regions. Also, the values of the elasticities used here ("Canadian industry parameters" in table 2) suggest the use of most plausible values for each sector. Citation of the sources of these values would add credibility to the results. In addition, some comments on the quality of the estimates of the capacity and employment elasticities would also help the reader in assessing the empirical results of the analysis.

Third, I have some severe doubts concerning the uniform treatment of changes in costs and employment across all sectors—particularly in treating agriculture and industry in the same manner. Are costs of production in both industrial and agricultural sectors measured here in the same manner? At one point in the paper the author indicates that the only source of cost changes considered is wage change. Changes in agricultural profitability in response to changes in trade policy tend to be capitalized into land values, which in turn alter the structure of agricultural costs. In future work I would suggest consideration of whether certain unique characteristics of any sector(s) mandate changes from the present treatment of all in the same way.

Finally, the model is only a real model, and, as such, ignores capital flows among regions. I am not sure how relevant it is to calculate

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[1] An important recent exception is the model of tariff liberalization in Cline et al.

exchange rates and wage rates which equilibrate the balance of trade, unless one assumes that all regions would somehow prohibit capital inflows and outflows. This seems somewhat unrealistic. The study would be strengthened if some parallel work on interregional capital flows were also carried out.

In conclusion, from the standpoint of the trade economist, Hazledine's study is innovative in a number of ways and represents an important addition to the stock of empirical multisectoral studies of changes in trade policy. However, the agricultural economist is likely to have certain doubts about how much one can conclude from such an aggregative treatment with respect to the regional effects of changes in the Canadian customs union on Canadian agriculture.

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Regional Policies for Agriculture: The Effects and the Future

George E. Lee

The Canadians in this audience and any others who have had even minimal recent contact with the Canadian media will be aware that the concept of region and a number of phrases relating to it, e.g., regional development, regional autonomy, regional resource use, etc., are currently both sensitive and critical issues in Canada. It is probably correct to say that Canadians are hypersensitive to regional issues at this time. Therefore, the issues of regional agriculture policies take on overtones that exceed the boundaries of the agricultural economist's traditional and ongoing concern for the income distribution and the general level of economic activity.

This setting gives rise to an immediate urge to discuss the problems of regional agricultural policy in terms of its short-run payoff to given regions; or more broadly, to calculate the "game values" in terms of income levels, or worse yet, levels of direct and indirect transfer payments to a sector or a sector within a region. This urge will be resisted and this paper will focus on the more basic and underlying themes within the context of regional agriculture policy issues and general economic development in the whole of the economy.

The Setting of Canadian Agricultural Policy

The conventional wisdom concerning Canadian agricultural policy is that it has been developed to serve the needs of a sector that has sufficiently strong comparative advantage to be used as a development vehicle for the remaining sectors of the Canadian economy. This view is held most strongly in relation to the period of the "National Policy" (the last quarter of the nineteenth century); however, it is valid as well for the fifty years previous and the fifty years following. While the latter twentieth-century development of the Canadian economy is much less centered on, fed by, and supported from the agricultural sector, the flavor of the role (at least until very recently) which agriculture occupies relative to the rest of the economy shows no major change.

A second and related characteristic and widely-held view of the setting in which agricultural policy operates is the consistent and pervading concept that the best-of-all agricultures for Canada can best contribute to the above role if agriculture is allowed to function (or be modified so that it will come to be able to function) as directed by the free and unconstrained direction of the competitive market. This of course does not mean that there have been, or are, no interventions on the part of governments. There were and are many. However, in almost all cases, these interventions were designed to be short-run and to be steps which led to an agriculture capable of effective operation at some later date when the intervention vehicles could be removed. At that time, agriculture would be the type of sector which could be termed efficient, adjusted, self-sustaining or, more recently, able to meet the demands of the user pay principle.

At the same time, agricultural policy in Canada has had to reckon with and has been influenced by the twin characteristics of being embedded in a (relatively) developed economy that is both geographically and politically (philosophically) diverse. We commonly recognize five political *cum* geographic regions in Canada. However, each of these in turn is an admixture of resource and institutional diversity. The differential effects of the pressures of adjusting to an interregional agricultural decline have caused the development of political pressures for programs that could ease the adjustment process.

An added complexity to the regional issues is the fragmentation of the institutional base at

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the farm level. Two organizations (Canadian Federation of Agriculture and the National Farmers Union) purport to be the national farm voice. However, the persistent development of an ever-increasing number of regional and commodity-based voices enforces the view that there is no central or collective will at the farm level. It appears there will not be one for some time to come.

At the legislative level, because agriculture under the British North America Act is stipulated as both a federal and provincial responsibility, the voice of the collective government bodies in the agricultural policy debate is scarcely less ambiguous than is the farm voice.

An additional characteristic of Canadian agriculture that falls out of the above diversity is the fact that the policies that bear indirectly on agriculture also have strong regional differential impacts. Monetary policy as it operates through its impact on the exchange rate can cause gross regional disparities in the level of hidden taxes borne by regions dependent upon export markets as compared to areas producing for the domestic market. Fiscal and institutional programs that effect labor or other selective input costs have a strong regional tax or subsidy-like effect that bears differentially on regions of agricultural production depending upon the intensity of the use of that particular resource. The extent of governmental support to the various modes of transportation is a further example of an indirect policy which bears heavily and in a differential manner upon regions of agriculture.

In this setting, if agriculture is to be a development tool, if it is to move to an unconstrained, self-sustaining user pay position, if it is a declining industry in a geographically and philsosophically diverse country, and, if it is to be administered by a complex federal-provincial collage of direct programs and indirect policies, then it is not surprising to find that it is difficult to define a Canadian agricultural policy in a precise and definitive statement. In this setting, it is not surprising to conclude that it operates by "muddling through" (Veeman and Veeman). In fact, muddling through seems not only appropriate as a description of the process of agricultural policy development in Canada, but unless a more narrowly defined objective can be found, it also may be an appropriate approach.

At the same time, a total acceptance of the muddling through concept with the acceptance of the marginal incrementalism and ad hoc adjustments which are part of this process places in severe jeopardy not only the approach, but also the viability of the agricultural economist as an agent in the whole policy process. This in itself is not a key issue unless it can be demonstrated that the profession can play a role that will result in an improvement in the policy process.

The question that must be faced by agricultural economists is, "Can we do better?" Do we have a body of theory, a kit of tools, or, as a minimum, a professional judgment that can lead to a better process and a better outcome?

Thus far this paper has dealt with what is. In the next part, an attempt is made to come to grips with the beginnings of a process that will allow our profession to do better.

The Essence of the Agricultural Policy Question

It is my opinion that the essence of the problem of agricultural policy analysis by the agricultural economist, be it regional or national policy that is being analyzed, is the question of the framework of the analysis which is to be undertaken. I question the adequacy of the framework(s) cast up by the conventional wisdom that I have attempted to summarize above. The conventional framework leads to one of the following two points of view.

The first is that the long standing and much discussed goal of a viable and independent market-oriented agriculture can be used as a signal to suggest that the majority of agricultural policy issues can be analyzed within the framework of the neoclassical market-oriented theory that conforms so closely in evaluation criteria to the purported goal of the Canadian Society.

The second point of view is that the complexity of our agriculture and the multiplicity of goals among the components of the agricultural system requires a political economic framework with only passing reference to marginality conditions and much more emphasis on political compromise as a goal identification and evaluation procedure.

The case to be argued here is that it is likely that both of the above frameworks are inadequate. The fundamental reason why I consider these frameworks to be inadequate is that through their use, we are not able to understand the agricultural industry supply response in a manner which has enabled us as economists to offer adequate prescriptions for policy that result in other than short-run and largely static solutions to the control of the supply of agricultural products. In a nutshell, the physical scientist has been able to remedy the "food problem," but the agricultural economist has not provided effective solutions to the "farm problem."

The evidence for this statement is that agricultural policy in Canada has not been translated into programs or actions that bear in any meaningful manner on either regions or on agriculture as a sector. This does not imply that there have been no attempts at regional or total sector policy. However, the bulk of interventions have been either interventions in the cost or efficiency of a resource, e.g., experimental stations to change the effectiveness of land in producing a chosen commodity, legislation to establish transportation (grain) costs, institutions to modify the cost of farm credit, etc., or interventions to modify the price and sale conditions of a particular commodity, e.g., boards for marketing milk, wheat, eggs, and deficiency payments of one sort or another.

This phenomenon is most certainly the result of a synthesis of the neoclassical microtheory and the political economy approaches. Neoclassical theory can deal most effectively with an input or an output. Fragmented political pressure bears on resource cost or product price as the most easily definable and quickly grasped "bad guy" in the system.

Since a region is only a small subset of the total agricultural mix of inputs and products, neither regional or sectoral problems of agriculture are adequately dealt with under the isolated input or commodity approach.

An important outcome of the emphasis of interventions by government into the aspect of resource use has led to an exaggeration of the supply problem in agriculture. This phenomenon can be described in the following manner. Piecemeal concern with the supply of, the quality of, or the full use of, a particular resource invariably leads to the uncovering of a process by which that resource can come into use in agricultural production. I will use an extreme example. Range land in Southwestern Saskatchewan was found to be submarginal for grain production and essentially zero rent-producing land even for cattle grazing. It was initially leased out at a very minimal charge. Over the past eighty years, improvements in water supply, grassland technology, and similar changes in institutions which gave rise to "commons" type grazing privileges in government-owned pastures have led to a viable beef cattle enterprise in the area. This enterprise can exist on very low returns because it is extremely low cost, most of the input cost is government-owned land that rents at a cost substantially below the current cost of private land. In other words, the intervention by government in various manners led to the establishment of an agricultural enterprise in the region. However, in those periods when the amount of beef demanded rises beyond that quantity which can be produced by this and similarly adapted areas increases in beef production are called forth based on resources which have far differently structured opportunity and market costs. In short, the intervention into the usability of one resource makes it more difficult for changes in the amount of product that can be produced to occur smoothly. It creates discontinuity in the product supply curve and thus exaggerates the income changes in both the up and down phase of changes in product demand.

Changes in institutions or rules which modify product price also create difficulties for a smoothly working change in amount supplied. Price levels that are stabilized for any length of time (no matter if the stability is market- or government-initiated) become capitalized into input prices and cause pain when they do change.

In other words, government intervention in its conventional form does not lead to a situation in which the industry can at some point "go it alone." This is removed entirely from the conclusion of whether government intervention is good or bad in itself. At issue is the concept that government intervention can lead to a stand-alone agriculture. My conclusion is that it will not do so under either resource or commodity manipulation.

This is a severe statement and should not and, I am sure, will not go unchallenged. It requires not only defense, but also will not be taken seriously unless some alternative is put forward.

A substantial, but not complete, search of the literature for kernels of thought that might offer amendments to our approach to enable us to deal with the agricultural supply phenomenon have led to the following. There are three concepts or approaches which I believe may enrich our thinking. The first is the analysis by Robinson (1958, 1962) which suggests that the economist has overlooked a significant difference in the structure of primary resource-based industries. She suggests this has caused us to misuse our analytical tools. The second is that developed by Breimyer (1962, 1978) who attempted to apply Robinson's concepts to agriculture in the United States. The third is from a recent address by Winch, who offered a new twist to the economics versus political economy argument. The first of the three in my view is an attempt to modify the classical theory. The second is an attempt to determine that agriculture is becoming industrialized and, therefore, Robinson's arguments are irrelevant. The third is a fresh approach to dealing with the problem via institutional means. I will elaborate on all three.

The main thrust of the Robinson concept is that the British and American tradition in economics has never dealt effectively with the manner in which price directs the level of production in primary production. Those types of products produced from resources which are naturally available (as opposed to produced resources) and are, therefore, available in an arbitrary quantity, as well as products produced from resources acquired through use, e.g., skill developed through learning by doing, tend to be produced to the limit of the supply of resources available. In my words, the inputs have no definable supply curves; therefore, the products produced have no definable supply curve. In this setting, price in the market determines income levels, but not quantity supplied. This Robinson compares with industrial production where price determines the quantity of product supplied; but, through the action of alternative use of resources, when price falls it has little other than very short-run impact on income levels.

When this concept is applied to regions of agriculture in Canada, there are many who are quick to point out that supply does change dramatically for many agricultural products. To this, I would agree but I would also add that the aggregate supply of agricultural commodities does not change rapidly except from natural causes such as weather.

I believe much thought and work should be applied to the Robinson concept to determine if it can provide insights into the agricultural supply dilemma.

Breimyer, in his earlier article (1962), divided the United States agricultural system into three "economies." These differed in the degree to which they met the characteristics of primary versus industrialized production systems. He saw the trend towards the industrialization of agriculture as the solution to both the food and the agricultural problem. He foresaw the time when continued increase in the use of nonfarm inputs, together with improvements in the marketing system, would allow the farm producer to be as responsive to supply and as controlled by competitive forces as the best of the industrialized sector.

In his more recent paper (1978) Breimyer suggests that current commodity shortages cause him to reconsider the trajectory he saw earlier. Off-farm inputs are not unlimited in supply. Farm land is still without opportunity cost and comes back into relatively more use as off-farm input prices rise. The additional message given in this later article is the need for agricultural economists to pay more attention to the economics of the extractive industries as they bear indirectly on food supply issues.

The third concept that I wish to bring into this analysis and which I believe goes a long way towards making operative the seminal ideas of Robinson and Breimyer is the one developed by Winch.

In his paper, Winch identifies the need to analyze the economic system in terms of the economic power of groups in that economic system. He analyzes the change in power structure that has occurred as our societies have evolved from static to market-oriented-developing to our current stage of mixed economic systems. It is exciting to attempt to incorporate the three economies of agriculture, the industrial economy, the extractive economics, and the consumer groups from Breimyer's article into the power group analysis of Winch.

Winch suggests that an analysis of the market alone in the current system offers little in the way of understanding the current market which is, and, possibly always was to some extent, only a simulation of the group conflict resolution that is the true basis of income distribution in an economic system. To tinker with the market is to tinker only with the simulator. This in no way changes the reality of the power groups who control the production and distribution process.

Winch suggests that any lasting solutions to policy in a market economy must reconcile a just price, an efficient price, and an equilibrium price. In the absence of power, our neoclassical theory provides the solution. Dwelling only on power (institutional economics) leads to solutions without efficiency. We need a reconciliation of power and efficiency.

The solution offered is that of decentralizing authority. Rather than market-directed efficiency or countervailing power-induced compromises, Winch suggests structures to obtain socially acceptable decentralized decisions. He offers the cross-section of society, board of governors approach as a possible solution. This consists of reasonable persons making reasonable decisions out of context of their own self-interest.

The most shocking aspect of the Winch solution is that it requires that the self-interest solution of each of the power groups (the aspect that the economist has been most equipped to determine) is played down. In fact, he suggests it must be left out of the analysis and replaced by the concept of group or social acceptability. This will make agricultural economists very uneasy.

The whole of the approach suggested here probably could be dismissed as academic day dreaming except for one thing. The deliberations on food policy, agricultural policy, and agricultural development that have gone on in Canada for the past year as symbolized by the government-industry-consumer strategy conferences of December 1977, January and February 1978 may in fact be attempts by the agricultural system to implement a version of the Winch solution.

Could it be that the agricultural economists' search for a policy analysis framework will bear fruit only after that framework has been put in place by more practical minds?

Summary and Conclusions

I began this paper by alluding to the critical issue of regional issues in Canada today. The calculated "game values" of regional policies are the sensitive issues. Canadian agriculture is by nature complex and resists analysis based on straightforward economic or institutional frameworks. Programs based on government intervention into single resource or commodity supply or price do little to lead to long-run solutions. Government interventions in an attempt to create an "interventionless" agriculture appear doomed to failure.

In searching for a more comprehensive framework for dealing with this question, we examined concepts relating to the character of the structural differences in parts of our economy together with concepts of how these structurally different sectors could be analyzed as a whole.

A reason for the lack of effectiveness of our traditional frameworks was found in the literature and a hypothesis is advanced that the policy development process is undergoing a change of which the profession of agricultural economics has not yet become aware.

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Discussion

David R. Harvey

George Lee has provided a thought-provoking paper and has raised questions deserving of more attention than they typically receive in the policy formulation process. The topic is obviously a timely one in that the federal government has made a commitment to establishing food and agricultural development strategies which, while still embryonic and therefore clouded in a certain amount of confusion and lack of explicit specification, do clearly demonstrate two overriding concerns. First, that the development of the food and agricultural system is deserving of, and can benefit from, a more coordinated and systematic policy approach. Second, that, in developing such an approach, the active participation of the provinces (regions) as well as producer and consumer groups and the processing-distribution-retailing (PDR) groups in the food chain is a *sine qua non.*

The major concerns of the agricultural and food strategies clearly have considerable political appeal, and, incidentally could well lead to a mechanism and model which is not substantially different from the Winch solution as applied to policy and program development. While Winch bases his ideas on the obvious importance of power concentrations and group activities in the operation of the "market mechanism," the ideas apply *à fortiori* to the activities of governments in augmenting or modifying these market mechanisms, particularly in a regional development context.

From a practicing economist's point of view, the lack of consensus within the social science disciplines on the characterization of the regional development problem and, therefore, on the overall framework for its solution, demands an eclectic approach, and implies a Winch-type approach to the implementation of any solution. In attempting to place Lee's observations and ideas in the context of some overall framework for regional development, the lack of consensus or clear direction from the body of received theory and analysis quickly becomes apparent and, indeed, is reflected very accurately in the history of "muddling through."

For example, neoclassical economic theory essentially dismisses regional problems as symptoms of market failure, and prescribes the cure as involving the removal of distortions to interregional competition (which is said to be undistorted if it results in a distribution of economic activity which obeys the law of comparative advantage) and the improvement of factor (principally labor) mobility. Aside from the somewhat questionable performance of this *laissez-faire* solution to the problem, and apart from the extraordinarily difficult task of actually making the principle of comparative advantage time-dimensional and thus operational, the prescription, involving often significant and continuing adjustment costs and interregional and off-farm migration, is seen by many as being part of the problem, not part of the solution. The dissatisfaction which Lee finds with the theory at the micro or farm level is thus reinforced at the more aggregate level. Nevertheless, the strength and power of the competitive ideology is certainly reflected in the typical characterization of the goal of regional development as one of enlightened welfare rather than efficient resource allocation and production (see, e.g., Economic Council and the goal of the Federal Department of Regional Economic Expansion in the *Canada Year Book,* which carries the caveat "without interfering with a high overall rate of national growth").

A major key in making sense of regional policies, and in developing alternatives, does seem to be the distinction between the short and long term and the adjustment costs incurred in changing economic and social structures. It seems clear that it is these undefined and even ill-understood adjustment costs (including political and social costs) which are a major deterrent to acceptance of the appropriately modified neoclassical solution as a longer-term strategy. On the other hand, the amelioration of perhaps necessary adjustment, which is often legitimately demanded by dis-

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advantaged regions, is very likely to impede, if not prevent, the longer-term reflection of economic realities. In that sense, the conflict is not between national growth now and regional development now, but rather between regional development and some national growth now, given the fixity of resources implied by high adjustment costs, and more growth tomorrow generated through more mobile and flexible resources. In other words, the Robinsonian asset-fixity type arguments have substantial merit as shorter-term explanations (and definition) of regional problems. But some solutions to these shorter-term problems may have serious implications for the longer-term direction and development of the industry and the regions. It is largely as a consequence of the overriding political concern with the adjustment costs and disequilibrium phenomena that public intervention does not lead to a "stand alone" agriculture.

The conclusion would seem to be that development policies must be eclectic, that they must not only include region specificity but also target group and time span specificity, so that distinctions are made between, for example, existing farmers and new entrants, part-time and full-time farmers, and the capital intensities and debt-equity positions of particular farming enterprises. Development policies must, in particular, deal explicitly and in depth with the dynamic (adjustment) mechanisms and responses and their implications for farm income, capital growth and needs, and farm structure. This is certainly in sympathy with Professor Lee's implication of concentration on input supply elasticities, and does suggest that the constraint on effective regional development policies is not so much money as the lack of imaginative ideas and extension/social engineering efforts and of explicit consideration of "disequilibrium" and dynamic phenomena. The outline of the Agricultural Development Strategy does, I think, open the door for such ideas and efforts and it remains for us to accept the challenge.

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The Development of a Food and Agriculture Policy in Quebec

Francois Dagenais

At the outset, I should like to express Ferdinand Ouellet's disappointment at not being able to accept your kind invitation, and to thank you for affording the Government of Quebec this opportunity to explain the development of our agro-food policy.

For some years now, agricultural development in Quebec has been in keeping with an agro-food policy. Therefore, this is not a new concept; but the operating mechanism for it within the framework of government only recently has become less restricted. Last spring, in an effort to promote the implementation of a comprehensive policy from producer to consumer, the Government of Quebec sponsored a socioeconomic conference on the agro-food industry. The results of this conference form the basis of my talk.

In this presentation, I will develop three major aspects, namely, regional development, provincial policy and external relations with the rest of Canada, and Quebec's other trading partners. However, before we focus on the present situation in Quebec, allow me to outline the development of agriculture in the Province during its recent history.

From the end of the nineteenth century to the beginning of the 1950s, Quebec invested large sums of money to settle its outlying regions. At the time of the 1929–30 economic depression, the government then in power promoted the settlement of such land, mostly in the Abitibi region in northwestern Quebec, by people from urban centers. This policy proved less fruitful than anticipated. Because of renewed economic activity in the industrial centers at the beginning of the 1940s, these colonization lands were abandoned, thereby resulting in a rapid decline in the farming population in the designated areas (table 1).

Table 1. Estimate of the Farming Population in Quebec, 1931–71

Year	Farming population	Farming population as % of total population
1931	777,000	26.8
1941	838,900	25.2
1951	792,800	19.5
1961	585,500	11.1
1971	334,600	5.6

Source: Econ. Stud. Serv.

During this period, agricultural development in Canada was more rapid than in Quebec, owing mainly to accelerated activity in the Western Provinces (table 2). In forty years, Quebec went from a better-balanced and more self-sufficient agricultural economy to one with a high degree of specialization and a dependence on feed grains from the Western Provinces. We specialized in dairy production which today is beset by a depressed market (table 3).

Quebec's Problem

If we examine our degree of self-sufficiency with respect to main food products, the trend of our agro-food sector becomes evident. The degree of self-sufficiency is the ratio of Quebec's production to its consumption, in

Table 2. Development of Agricultural Production in Canada and in Quebec, 1935/39–1976

Period	Canada	Québec
	%	%
1935/39	74.6	76.6
1945/49	85.4	74.0
1955/59	107.4	91.5
1965/69	144.4	112.1
1971	159.7	116.9
1976	178.0	123.4

Source: Econ. Stud. Serv.
Note: Physical volume of agricultural production based on that of 1961 taken as 100.

Francois Dagenais is assistant deputy minister of the Quebec Department of Agriculture.

Table 3. Farm Receipts from the Sale of Various Quebec Products, in Millions of Dollars (Percentage in Parentheses Below)

	Wheats	Oats	Barley	Other Crops	Large Cattle, Calves	Hogs	Dairy Products	Eggs and Poultry	Other Receipts
1935–39	0.3	2.0	1.0	12.0	8.0	12.0	32.0	7.0	11.0
	(0.4)	(2.3)	(1.2)	(14.1)	(9.4)	(14.1)	(37.5)	(8.2)	(12.9)
1976	1.0	3.0	0.1	122.0	127.0	237.0	616.0	192.0	32.0
	(0.1)	(0.2)	—	(8.4)	(9.5)	(17.8)	(46.3)	(14.4)	(2.4)

Source: Econ. Stud. Serv.
Note: Oilseed crops are not listed.

physical units for various food products. It is an index of the extent of the market covered by Quebec producers. If the degree of self-sufficiency is greater than 100% for a product, a net portion of the production is sold to the other Canadian provinces or on foreign markets.

As shown in table 4, the degrees of self-sufficiency in 1976 were greater than 100% for dairy products, pork, and poultry, but lower for beef (21.8%), fruits (11.1%), vegetables (40.8%), and cereal grains (35.4%).

A comparison of tables 4 and 5 reveals that for products such as beef, fruits, and vegetables which have the best prospects for increased per capita consumption, the degree of self-sufficiency was not only very low in 1976, but there also was a declining trend between the average for the 1970–74 period and 1976. In other words, the domestic supply is only slightly oriented toward the dynamic demand.

Thus, in order to increase the sale of Quebec agro-food products by replacing some of the imports by domestic products, we would have to reverse this situation and raise the degree of self-sufficiency in products for which there is an active domestic demand. However, constraints are numerous in terms of such factors as quality of the soil, climate, productivity, input costs, technical expertise, marketing, and competitiveness at the processing level. A federal agro-food policy constitutes a further constraint in that, in practice, it seems to tend to fix agriculture in the provinces to their present areas of specialization.

For these reasons, the objective of increasing Quebec's self-sufficiency in the dynamic sectors has become a priority. This requires the implementation of a series of policies and the availability of means and resources not only at the primary production level but also at the level of processing and commercial channels.

For this objective to be reached, there must be the widest possible consensus of all the representatives from the agro-food sector. It is with this aim in mind that, last spring, Jean Garon, the Quebec Minister of Agriculture, agreed with his colleagues and called a socio-economic conference on the development of the agro-food industry.

On the occasion of this economic summit, René Lévesque, Premier of Quebec urged: "We must strive for maximum self-sufficiency since it is essential for the general and economic well-being of our society. Not only is it essential for the economic well-being of a so-

Table 4. Degree of Self-Sufficiency in Quebec's Main Agro-Food Products, 1970–76

Main Products	Average 1970–74	1975	1976
		%	
Milk and dairy products	122.6	128.0	118.3
Livestock and meat (excluding poultry) including	44.7	47.4	47.9
beef	(24.1)	(19.3)	(21.8)
pork	(71.8)	(106.1)	(104.7)
Eggs and poultry			
poultry	106.3	98.8	103.8
eggs	63.3	74.7	82.5
Fruits and vegetables			
fruits	21.3	16.4	11.1
vegetables and potatoes	45.5	44.1	47.7
potatoes	(49.6)	(40.9)	(54.6)
vegetables	(41.5)	(47.8)	(40.8)
Fodder grains	28.0[a]	28.6	35.4
wheat	(8.7)	(11.0)	(24.5)
oats	(57.2)	(62.0)	(64.9)
barley	(4.6)	(6.3)	(8.4)
grain corn	(36.9)	(28.0)	(38.2)

Source: "Coup d'oeil sur l'agro-alimentaire au Québec," 1977; MAQ, Québec, 1977.
Note: Degree of self-supply: domestic farm production in relation to consumption in the Province.
[a] For fodder grains, the figures are for 1974 and not the average for the 1970–74 period.

Table 5. Rate of Variation in Visible Per Capita Consumption of Food Products for Quebec and Canada 1970–74 to 1976 and 1961 to 1973

	Average 1970–74 to 1976[a]		1961 to 1973
Main Products	Québec	Canada (annual average rate of variation)	Canada
	%	%	%
Dairy Products (in pounds, whole milk equivalent)	−0.3	−0.7	−1.3
Meat (in pounds, slaughtered weight)	−0.7	+1.9	+1.1
including:			
beef	+4.2	+5.1	n.d.
pork	−6.0	−3.1	n.d.
Poultry (in pounds, eviscerated weight)	−1.4	0	+3.5
Eggs (dozens)	−4.4	−2.7	−1.2
Fruits (in pounds, fresh equivalent)	+6.8	+3.3	+1.4
Potatoes (in pounds, fresh equivalent)	+2.9	+5.3	−0.4
Vegetables (in pounds, fresh equivalent)	+2.6	+2.9	+0.7

Source: "Coup d'oeil sur l'agro-alimentaire au Québec," 1977; "L'économie agricole au Canada," vol. 2, no. 1.

[a] The year 1976 is compared to the average for the 1970–74 period; the annual average rate of variation is for a 4-year period, i.e. from 1972 (taken as a representative year for the 1970–1974 period) to 1976. This rate was determined by the compound interest method.

ciety, but it is equally important for its dignity, its basic dignity, in a world where hunger has still not been conquered" (L'agro-alimentaire).

Why Were Regional Programs Chosen?

One of the main concerns of those directly involved in Quebec's agro-food sector is to break into existing markets. Often, however, the distribution channels are controlled by bodies outside the Province. It is not easy to get around such distribution channels, but it is possible for us to cut into channels entirely within the Province which are set up outside the major urban centers.

Moreover, owing to Quebec's over-specialization in dairy industry, the government is attempting to diversify agriculture in the Province by orienting it toward products for which there is a more dynamic demand. The department of agriculture has thus approved two important programs, one for the rationalization of the meat sector and another for feed storage and handling facilities to increase self-sufficiency in feed grains.

With regard to the meat sector, the department of agriculture had two options.

The first was rationalization by promoting the construction of two or three large slaughtering units and thereby attempting to tap national and international distribution markets. For this to materialize, it was necessary to have a sufficient supply, which, with the exceptions of pork and beef for boning, is not the case in Quebec. Such abattoirs would have taken considerable time to become sufficiently profitable, and specialization would have centered on beef production dependent on feed grain imports, hence its instability in view of grain price fluctuations.

The department has preferred to promote the second option, which is the development of regional abattoirs capable of supplying local markets with local production, the latter being based on available resources which otherwise would not be developed. The first market to be filled doubtless will be the freezer market which, involving very short marketing, allows for a maximum of added value to remain in the area. We hope that, after a few years of such a system, when specialized beef production has increased, it will be possible to supply bigger markets by combining services for small and average enterprises.

Feed grains

From 1970, the Quebec government has favored a policy of self-supply in feed grains on the farm, which had some success especially with dairy farmers. However, this policy has not yielded the expected results with hog and poultry producers because of their lack of interest in these crops.

On the other hand, grain production on specialized farms encountered two major problems: the quality of the grains and regularity of supply. Because Quebec feed grains were not graded and because it was impossible to set delivery schedules, buyers often preferred western feed grains because they are graded and delivered at fixed times. In order to obtain better marketing of grains and, hence, better prices for growers, the government has adopted a program for the construction of regional centers for the drying and storage of grain. These centers will enable growers to deliver their grains to a central place where they will be dried, graded, and stored, and then sold through regular marketing channels.

During this time, the governments of Quebec and of Canada signed an agreement to finance a program for the storage on the farm of grains and forage which would favor the program of self-supply on the farm.

It is hoped that all these measures will lead to a 50% increase in the commercial marketing of grains and in their production.

A number of other regional programs totaling $9.7 million and spread over five years were recently approved. These programs were prepared in consultation with representatives of farm producers. The essential aim of these programs is the development of regional agricultural production, which cannot be attained by the department's regular programs, and the development of economic family farms in outlying regions.

These programs aim to promote the growing and also the processing of new crops in certain regions. Several measures of these programs are designed to provide sufficient financial means and management assistance to enable small farm producers to reach the stage where they can make a decent living for their families out of their farms.

Quebec Programs

The programs implemented by the Quebec government have two aims: to guarantee reasonable returns to farmers so that they will be encouraged to grow certain crops and to allow them to acquire production means which will favor increased productivity.

Programs for Increased Productivity

These programs have been available for a number of years but are frequently modified. I shall mention only a few: some concern livestock production, and their aim is to improve the quality and health of animals and promote artificial insemination. The department devotes about $19 million to these programs. Others concern better crop production through the use of fertilizers and better seed. The work related to these programs is carried out in government research stations or by farmers who receive financial assistance for this purpose. The cost of the programs in this sector is about $3.5 million. In addition to this sum, subsidies amounting to about $10 million are devoted more specifically to agro-food industries. For the purposes of this paper, we shall speak of two programs in this connection, namely, farm credit and subdrainage.

The first of these programs is for all farmers whose principal occupation is agriculture. The Farm Credit Bureau, which administers many acts in this field, helps farmers through loans suited to their different conditions and through different subsidies totaling $40 million. This program gives farmers access to credit at a cost in keeping with the profitability of their farms. This credit policy benefits farmers who need capital to get started or to modernize these enterprises. On the other hand, there is a risk that interest subsidies and increases in loan ceilings, if poorly administered, will lead to inflated land values at certain times.

Farmland improvement programs take two forms: mechanized projects for which the 1978–79 budget is $9.5 million and subdrainage works estimated at $18.6 million. Where subdrainage is not essential, the Quebec government subsidizes part of the work to allow for better drainage. In all other cases, the Department of Agriculture bears about half the cost of installing the subdrainage system. As our climate is uncertain and often rainy, this is essential if we wish to encourage crop production, including cereals. We hope this system will result in an appreciable increase in the productivity of our fields and encourage farmers to grow new crops, such as grain—corn, wheat, alfalfa, and others of high nutritional value.

Farm Income Stabilization Program

For the past four years, the Quebec government has directed its efforts towards a farm income support and stabilization policy. This program resembles that of British Columbia. The primary aim of this measure is to guarantee participating farmers an income comparable to that of skilled workers in other sectors of the economy. This income insurance plan is optional and the government pays two-thirds of the premium, while the farmer pays the rest. The schemes now in force are based on production costs established in consultation with farmers' representatives. The farming methods on which these production costs are based are those normally used on an efficient family farm. Farmers may insure a production equal to that of a family farming unit. Farm income stabilization insurance schemes are now available for beef, piglets, and potatoes. Others are being prepared for corn, barley, oats, and wheat.

The productions chosen are those that Quebec wishes to develop and in the case of which great insecurity of income limits investment. These income stabilization schemes enable farmers to stay in production when the market does not adequately repay their expenses. We hope that this system, if wisely applied, will enable farmers to expand much faster than if there were no such measure. In addition to administration expenses, the schemes will cost the government $7.9 million in 1978. But, Quebec being situated at the northern limits of farming, the price to be paid to preserve its agriculture will always be higher than, for example, in Southern Ontario.

Other measures

The farm products marketing policy of the Government of Quebec is under attack from various quarters. Thus, l'Union des producteurs agricoles du Quebec, a body composed of all Québec farmers, would like to have marketing structures which are called "joint plans," without having to hold a referendum for their adoption. However, the government requires a referendum for each production unless conditions make it impossible to hold one.

Integrated producers, mainly of hogs and poultry, are contesting the role of joint marketing plans for their products because they consider that they limit the possibilities for dynamic people. As we shall see later, provincial joint plans are the basis for national plans.

Private enterprise also denounces the Quebec government's apparent liking for the cooperative movement. In the processing of farm products, the cooperative sector, mainly represented by the Coopérative fédérée and all its subsidiaries, is among the most dynamic enterprises in the Quebec agro-food sector.

In Quebec, cooperatives constitute the sector in which the control is exclusively in the hands of Quebecers. As cooperatives return all their profits to their members, it is normal to encourage them rather than capitalist enterprises which often send their profits outside the community.

The preservation of farmlands is another aspect of the Quebec agro-food sector which is favored by some and opposed by others. (It is to be noted that Quebec is one of the provinces where the acreage of good farmland per inhabitant is lowest.) Journalists are now predicting legislation in this connection for the fall; time will tell if they are right.

We cannot omit mention of the sometimes negative "fall out" which may arise from over-strict environmental protection measures. This is a consequence of the growth of cities and towns within the already unique Quebec farming zone.

Interprovincial Policy

The Government of Canada is trying to establish, with the rest of Canada, a policy of interprovincial agreements concerning a marketing of farm products. In doing so, it is complying with the constitutional philosophy that presided at the creation of Canada. This policy is subject to the goodwill of the other provinces to cooperate in mutually acceptable agreements.

The egg producers have signed an agreement for the marketing of eggs in Canada. The provincial governments, through farm products marketing boards and the provincial departments of agriculture, have ratified this agreement. Subsequently, the Government of Canada countersigned the agreement between the provinces, promulgated it, and is seeing that it is applied and complied with. This agreement enables the Government of Canada to control the imports allowed by GATT, allocate production quotas to the provinces, establish a pricing system based on production costs, and buy up eggs when there are surpluses.

This type of national marketing plan has also been established for turkeys, and another is before the federal cabinet and awaits royal assent. Other productions also should be covered, but it is not the government's role to decide which ones and when they should be implemented. We take it for granted that it is the producers who know their own problems best and how to solve them. This could be called democratic planning of farm products marketing.

Certain provinces obviously are watching the development of certain productions in Quebec with some concern. You must realize that there are advantages in producing these commodities and that Quebec's policies provide the incentive needed to proceed in that direction.

During the agro-food summit, we attempted to establish our competitive position taking into consideration the United States, our major trading partner and competitor.

Some surprising statistics are revealed in table 6, which shows the prices obtained by farmers in Quebec and in the United States for milk, beef, veal, pork, chicken, turkey, eggs, and potatoes reduced to a common price index. The various products have not followed the same trend. For example, in the cases of milk and of turkeys, there is a greater price difference, whereas it is diminishing in the cases of beef, chicken, and eggs, and is relatively stable for the other products.

Table 6. Farm Price Index (Base 1971 = 100)

Year	Quebec (in US dollars)	United States (in US dollars)
1961	76.8	74.9
1966	88.4	89.9
1971	100.0	100.0
1974	166.4	141.7
1975	188.8	148.6
1976	193.6	150.7
1977	183.2	149.6

Source: Calculations by the Economic Studies Services, Quebec Department of Agriculture.
Note: Laspeyre formula.

After studying these figures, one realizes that the Quebec government is carefully examining policies to make Quebec farmers more competitive on their domestic market and on foreign markets. As a result of the agro-food summit, the Quebec Department of Agriculture is in the process of establishing a policy encouraging the grouping of small and medium-size enterprises through the sharing of common services to enable them to enter foreign markets, which is what the manufacturers are hoping for.

Conclusion

Since November 1976, the Government of Quebec has formally undertaken to make the development of agriculture and the food sector one of its priorities. This choice is based on an economic study. The agro-food sector is the one which could produce the greatest multiplier effect when local resources are used to develop it. Because the culture of Quebec is slightly different from that of its Canadian and American neighbors, in particular its eating habits, it is understandable that Quebec's food system differs from that of her neighbors. We hope our neighbors will be able to appreciate our eating habits when they come to visit us or import our specialty products.Many of us are asking ourselves about the economic impact of a constitutional reform. One thing is certain: Quebecers will still be eating and the food will be purchased, in Quebec or elsewhere, according to prices, quality, and services. Politically, it is essential that a thriving farming industry be maintained because feeding one's self is the first form of independence.

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Discussion

Robert St. Louis

The title of this section suggests that questions are being raised about the economics of both federal and provincial agricultural policies in Canada. In this discussion, I intend only to explore some possible reasons why new orientations of Quebec agricultural policy are unfolding the way they are now and to make a few comments about the economics of it within a North American context.

We have been told previously that the cornerstone of Quebec agricultural policy more and more will come to rest on the pursuit of the following operational goals: (*a*) stabilization of farmers' income; (*b*) supply management via marketing boards (*plans conjoints*) with interprovincial agreements, whenever possible, on market shares as a *modus vivendi*; (*c*) improvement in the availability and the quality of public and private services to agriculture; and (*d*) strengthening of Quebec agribusiness in general and of the cooperative system in particular, within the perspective of gradual substitution of local production to imported agricultural commodities whenever appropriate, and to imported farm inputs whenever these can be locally produced.

In many regards, ongoing Canadian agricultural policy in general and some provincial agricultural policies as well may remind you of the Kennedy era of the early 1960s, when a serious attempt was made to build up a consistent set of agricultural policies with the declared objective of using supply management as the cornerstone of policies aiming at maintaining high price supports for U.S. agriculture (Gilson). But why is it that the Quebec government would go for supply management as one of its leading operational goals, in view of the fact that a greater share of its own consumers' budget in the hands of locally producing agribusiness is also a target to contend with? Moreover, one may rightfully wonder whether or not this is good economics for Quebec, for the rest of Canada, and for other trading partners of Quebec as well, that this package of operational goals be pursued simultaneously by Quebec.

My own view on these questions are the following. Both the size and the composition of Quebec agriculture are more and more constrained by the four traditional characteristics of most developed economies; namely, lagging demand, output increasing technology, slow resource mobility out of agriculture, and outside economic forces that affect farmers (Hathaway). But there are two other characteristics that are perhaps unique, as a combination, to Quebec agriculture. These are the relatively high importance of feed-importing animal production, especially hog and poultry, and the existence of a single and rather strong farm organization which acts as a lobbying group for its members.

In view of this, I think that Quebec governments have traditionally gone and will keep on going the agricultural supply management route for practical reasons including strong pressure from the farmers. But I do not believe that Quebecers have gone and will keep on going for it spontaneously and in a unique and rigid fashion. Historically, there were in fact no reasons not to go that route in those productions where other leading provinces were joining the bandwagon, and especially in those groups of commodities where demand was almost not responsive to price and income changes anyway. Moreover, I think that it is the feeling of the actual government of Quebec that the danger of overpenalizing local consumers with high prices may not be too great since it is an input-importing agriculture operating within a free-trade national economy to a given extent in some productions (those with provincially determined market shares) and to a full extent in others (those without such barriers to interprovincial trade).

Is this good economics for the people of Quebec? I think it is no better economics for Quebec than anywhere else in Canada, because farm resources tend to become frozen in their actual use. Is it good economics for the rest of Quebec trading partners that Quebec agricultural policy become still more strongly

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oriented towards those operational goals? I would not dare answer such a question because no one knows how far North America as a whole is from equilibrium use of farm resources. But I think market-sharing arrangements are in a way a *modus vivendi* that may have the following characteristics: they are probably a means of achieving national policy objectives at a cost slightly higher than deficiency payments, for instance; but they have the advantage of transferring at least part of the cost of agricultural policy from the taxpayer to the consumer of food.

Oddly enough, the strongest opposition to supply management in the United States at the end of the Kennedy era came from the farmers themselves (Gilson). Will the same thing happen soon in Quebec as well as in the rest of Canada? I do not know but I have a serious doubt about the willingness of dairy producers in particular to give a try at loosening their hold on supply management.

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Abstracts

Symposia

The Food Stamp Program and Welfare Reform. William T. Boehm, chairman (ESCS, USDA), D. Lee Bawden (Urban Institute), Maurice MacDonald (University of Wisconsin), and Lester V. Manderscheid (Michigan State University)
Proposed elimination of the Food Stamp Program (FSP) has been the subject of fundamental philosophical and academic discussion. That program was designed to ensure that low income households have sufficient food-buying income to purchase nutritionally adequate diets and, as a companion goal, to support farm income. Proposed elimination raises questions about what would happen to diets of the poor, aggregate food expenditures, and farm income. How such changes would affect the utility of recipients and taxpayers is also being discussed.

The symposium featured four economists knowledgeable about various aspects of the Food Stamp Program. Dr. Lee Bawden discussed the proposed elimination of the FSP from the point of view of a social welfare economist. His discussion focused on the issues and arguments which tend to favor retention of the FSP. Dr. Lester Manderscheid argued that the Food Stamp Program is more efficient in increasing food expenditures than a cash transfer would be. Dr. Maurice MacDonald presented and discussed the arguments for elimination of the program. His research suggests that the program is not achieving its objectives because less than 60% of all households eligible actually participate.

Current Farm Financial Conditions and Credit Policy Responses to Financial Stress. Emanuel Melichar, chairman (Board of Governors of the Federal Reserve System), Gary Benjamin (Federal Reserve Bank of Chicago), Marvin Duncan and C. Edward Harshbarger (Federal Reserve Bank of Kansas City), Gene Sullivan (Federal Reserve Bank of Atlanta), Michael D. Boehlje (Iowa State University), James Thornton (Farmers Home Administration), and George D. Irwin (Farm Credit Administration)
Quarterly Federal Reserve Bank surveys of rural bankers in the Corn Belt and the Great Plains, last conducted on 1 July 1978, have indicated a marked improvement in the cash flow and debt repayment position of farmers, compared with the situation in the summer of 1977. In the Southeast, drought conditions have been relieved somewhat, and substantial disaster loans from the Farmers Home Administration and Small Business Administration also have helped to improve farmers' financial positions. However, the liquidity of most rural banks has improved only marginally from the unusually tight positions reached in 1977, and thus loan fund availability continues under pressure.

In the face of farm cash-flow problems, the most commonly reported response of borrowers and lenders has been to refinance short-term loans into longer-term mortgage debt, thereby seeking to adjust the farmer's debt repayment schedule to his reduced debt-servicing capacity. Evidence was presented, however, that such refinancing cannot always solve the farmer's problem. Some farmers may have to liquidate some assets unless land prices continue to rise rapidly.

The Emergency Agricultural Credit Adjustment Act of 1978, signed on 4 August, authorizes the Farmers Home Administration to make or to guarantee loans up to $400,000 to refinance debt and for other farming purposes (except to purchase additional land) for farmers who cannot otherwise obtain such loans. The Farmers Home Administration foresees a substantial demand for loans under this program. The Farm Credit Administration, however, projects little use of such loans by its borrowers, though perhaps greater use by banks and other commercial sources.

Energy from Agriculture: The Food-Energy Interface. Fred J. Hitzhusen, chairman (Ohio State University), Norman Rask (Ohio State University), William Larson (USDA, University of Minnesota), Wesley Buchele (Iowa State University), and Wallace Tyner (Purdue University)
The increase in the relative prices of energy may open up potentially vast new markets for agricultural biomass resulting in increased competition for food production resources required for basic food needs. This is the emerging food-energy interface and it raises a wide range of questions. What are the implications for malnutrition and starvation in countries that are already food deficit? What will be the water availability and soil loss implications from increased marginal land biomass production and/or removal of crop residues for energy? What technological breakthroughs are needed or possible for the breeding, harvesting, transporting, and processing of various biomass energy products? What are the policy trade-offs between subsidizing farmers to set aside acreage and/or store their crops, and subsidizing alcohol production from grain? What factors are necessary for the establishment of long-term, stable markets for energy from agriculture? These and many more questions must be addressed by agricultural economists if informed individual and collective choices are to be made at the food-energy interface.

Working with Small Farm Operators. Dennis K. Smith, chairman (West Virginia University), George L. Brinkman (University of Guelph), W. Arden Collette (University of Florida), David R. Orden (Virginia Polytechnic Institute and State University), Evans R. Scyphers, Jr. (Virginia Cooperative Exten-

sion Service), and Dalton McAfee (North Carolina Agricultural and Technical University)
Small farm operators are not a homogeneous group, but have different farming potentials, interests, management abilities, and aspirations. Accordingly, needs for assistance vary and range from credit and land expansion programs to basic management training and welfare assistance programs. The small farm program audience is distinctly different from the general farm audience that is the regular clientele of the Extension Service. One-to-one contact and interpersonal channels of communication are the most successful means of achieving adoption of new ideas by small farmers. Quite often small farmers contacted in this manner eventually become participants in regular extension programs. A recent survey indicates that all of the southern states have special small farm programs that make widespread use of paraprofessional extension workers. In general, the programs are oriented toward farmers who have relatively low income, resource, and education levels, and who do not participate in regular extension programs.

Risk/Benefit Analysis of RPAR Pesticides: Improving the Economic Input. Arnold L. Aspelin, chairman (Environmental Protection Agency), Fred T. Arnold (Environmental Protection Agency), Bobby R. Eddleman (Mississippi State University), Fred Abel (Department of Energy), John Schaub (U.S. Department of Agriculture), Donald Epp (Pennsylvania State University), and Michael McWhorter (Texas A&M University)
Economic analyses are an important input to regulatory decisions on problem pesticides under the Federal Pesticide Law (FIFRA). Economics has been a significant and increasing input to major decisions during the 1970s. Some pesticides are being maintained due to substantial economic benefits of continued use even though there is at least some level of human health or environmental risk. For example, the Environmental Protection Agency recently has recommended continued usage of a pesticide in a food use, even though the chemical is a carcinogen based on animal test data. The recommendation was made because of the substantial benefits to agricultural users of the pesticide and to consumers. (Benefits were judged to outweigh the risks which is the decision-making criterion under FIFRA for determining registrations of pesticides.) Risk/benefit analyses are conducted rather than true cost/benefit analyses where all impacts would be reduced to common units, such as dollars. Data bases and analytical resources are insufficient to permit full utilization of the concept of cost/benefit analysis.

Economic impact analyses focusing on the benefits of the use of pesticides are conducted by multidisciplinary interagency teams consisting of personnel of EPA, USDA, and the state experiment stations. Analyses involve evaluation of economic impacts at the levels of pesticide users, intermediate industry, and ultimate consumers as well as at the macroeconomic level (also social and community impacts in the event of significant economic dislocations). Partial budgeting and mathematical programming have been the primary analytical methods in the past. Expanded use is being made of programming and econometric models, taking into account biological parameters regarding such factors as pest infestation and damage. Efforts are also underway to do detailed assessments of the costs and benefits of pest control on a detailed "commodity basis" without reference to specific regulatory actions that may be taken by EPA. Such longer term studies provide comprehensive benefit/cost data which greatly expedite economic impact analyses for pesticide regulatory matters and also improve their analytic rigor. There was a discussion of utilizing the concept of net producer/consumer surplus as an analytical method for conducting analyses including adjustment of net benefits for distributional and external impacts. It has merit but is subject to considerable data limitations. A discussion also was presented of risk/benefit tradeoff matrices now being utilized in pesticide decision making at EPA. The recommendation was made to improve interphase of economists with the biological sciences by such vehicles as multidisciplinary symposia at national meetings of professional societies.

Computerized Rural Development Decision-Making Aids for Field Application. Luther G. Tweeten, chairman (Oklahoma State University), Gerald A. Doeksen (Oklahoma State University), Kenneth C. Clayton (University of Florida), James R. Nelson (Oklahoma State University), H. Evan Drummond (International Training Office, USDA), and Reuben N. Weisz (NRED, ESCS, USDA)
Local decision makers in rural areas are continuously faced with a broad spectrum of economic problems including (*a*) evaluating local impacts of economic development, (*b*) providing adequate community services within local government budget constraints, (*c*) planning government finances with changing tax bases, and (*d*) planning for land-use changes associated with economic development and growth. These are particularly difficult problems for small units of government who do not have professional planning staffs and other trained personnel to assist in decision making.

Considerable research has been conducted related to these problems, but extension field personnel and others have difficulty applying generalized research results and sophisticated research-based methodologies to local situations. With current technology, field accessible computerized models can be used to minimize these problems. Doeksen discussed the adequacy of current research in facilitating such applications. Specific types of rural development problems and existing operational computerized models to address these problems were discussed by Clayton (development impact), Nelson (community services), Drummond (local tax bases), and Weisz (land use).

United States Government Policies for Tobacco. Ernest W. Grove, chairman (ASCS, USDA), Robert H. Miller (ESCS, USDA), Verner N. Grise (ESCS, USDA), Kenneth M. Friedman (U.S. Department of Energy), Bruce L. Gardner (Texas A&M University), Dale M. Hoover (North Carolina State University), Roy B. Davis, Jr. (Virginia Department of Agriculture and Commerce), Max Loyd (Clemson University), and Harold Love (University of Kentucky)

The papers and discussion covered important issues stemming from governmental tobacco programs, some of which are regarded as conflicting. These issues included price support levels, loss of markets, trade policy, mechanization, farm or quota consolidations, changing structure of tobacco farms, farm family incomes, effects on rural communities, the taxation base for states, the welfare economics of the tobacco program, costs to government and to consumers, taxation of tobacco products, and restrictions on advertising and other antismoking legislation. But, the two most basic issues, as pointed out by Friedman, Gardner, and Love, are (*a*) the political paradox underlying current attitudes toward tobacco producers, and (*b*) the conflict between individual and corporate rights and duties in the tobacco industry and the rapidly growing role of government in the area of public health.

An attempt to reconcile some of the policy conflicts was made by Friedman, a political scientist, who argued that, since many smokers will continue to smoke, there should be a policy of "detente between the tobacco industry and progressive health interests" to promote a reduction in the health impacts of smoking. This argument was generally accepted by the panel. But it was concluded, nevertheless, that growers have a strong interest in continuing the tobacco program, and that debate will continue as to the proper role of government in the area of smoking and health.

The Farm Cost-Price Squeeze: Problems of and Management Strategies for Beginning and Established Farmers. Allan E. Lines, chairman (Ohio State University), Bobby H. Robinson (Clemson University), Earl I. Fuller (University of Minnesota), and Benny R. McManus (University of Tennessee)

Robinson set the stage by reviewing the current cost-price squeeze. He discounted the use of price indices (parity) as a means of assessing the farm problem and suggested the use of measures such as realized net income, farm assets, disposable farm income, and debt/income and price earnings ratios. A contrast of the current situation with historic cost-price squeezes found similarities and differences.

Fuller focused on choosing between alternative strategies for beginning farmers. A recognition of "realities" is a must for every beginner—continuation of cost-price squeeze, inflation, foregone consumption, physical and economic laws, and the need for management, language, and technical skills. He discussed strategies for acquiring land, livestock, buildings, and machinery and strategies for reducing risk so that financing can be obtained.

McManus stressed goals and management strategies that can be effectuated internally by the farmer rather than relying on government programs to solve problems created by the cost-price squeeze. He recognized farmers have multiple goals that must be reassessed during cost-price squeezes. Guidelines and strategies (production, marketing, and financing) for surviving cost-price squeezes were presented. Of the three expansion strategies (cash, maximum debt, and phased) McManus favored phased, because it fits well with cyclical high and low profit periods. He also discussed liquidation strategies and some cogent observations of successful managers.

Annual Agricultural Outlook Survey. Norman Coats, chairman (Ralston Purina), John Ikerd (Oklahoma State University), John Ferris (Michigan State University), Gene Futrell (Iowa State University), T. E. Nichols (North Carolina State University), Rex Daly (ESCS, USDA), and Bruce Scherr (Data Resources)

This symposium was based on a survey of annual outlook information provided by the AAEA membership. Estimates of supplies and prices were included for the years 1978 and 1979 for the major agricultural commodities including both livestock and crops. Outlook information also was summarized for agricultural costs and returns and for selected general economic indicators.

The symposium consisted of a presentation of the basic statistics obtained from the survey results followed by a discussion of the various components of the survey by a panel of outlook economists who gave their views of the agricultural outlook. A major portion of the symposium was devoted to open discussion among panel members and those attending the symposium.

Vertical Organization and Coordination in Selected Commodity Subsectors. Marvin L. Hayenga, chairman (University of Wisconsin), Lee F. Schrader (Purdue University), George B. Rogers (ESCS, USDA), Clement E. Ward (Oklahoma State University), Dennis R. Henderson (Ohio State University), Donald J. Ricks (Michigan State University), Ronald W. Ward (University of Florida), Gerald R. Campbell and Annie Yuen (University of Wisconsin), and Larry G. Hamm (ESCS, USDA)

Four papers were presented highlighting the dominant organization and coordination features in the broiler and egg, beef, citrus, tart cherry, and processed peas, sweet corn, and snapbeans subsectors. The reasons for the dominance of those features were explored, along with some noteworthy performance implications. These highlights of in-depth subsector studies conducted as part of North Central Regional Research Project 117 were followed by a comparative cross-subsector analysis of the vertical organization, coordination systems and performance in those subsectors (and dairy). The commonalities and differences in structure and coordination systems within these subsectors were described, reasons for those similarities or differences were explored, and some hypotheses were suggested regarding the interrelationships among the structural features of the vertical commodity systems, the coordination mechanisms employed, and the performance of the subsectors. The papers presented are available as working paper WP-20 from NC-117, 905 University Avenue, Room 209, Madison, Wisconsin 53706.

Natural Resource Systems: Specification, Estimation, and Analysis. Jon M. Conrad, chairman (Cornell University), Oscar R. Burt (Montana State University), Ronald G. Cummings (University of New Mexico), and Gordon C. Rausser (Harvard University)
Applications of the relatively recent advances in the theory of resource economics face significant and often interdependent problems throughout the specification, estimation, and analysis process. A discussion of some of these problems was stimulated by three formal presentations.

Professor Burt presented a paper examining the dynamic relationship between crop rotation in the Northwest and soil conservation. The optimal percentage of land planted in wheat is derived for both two-state and single-state variable models under alternative wheat prices. In the single-state model, an approximately optimal decision rule gave essentially identical values to an exact solution obtained by DP. It was concluded that high support prices for wheat could encourage significantly higher rates of soil erosion.

Professor Cummings discussed recent research applying the theory of pure exhaustion to the Hot Dry Rock (HDR) geothermal resource. Initial results reveal management strategies, specifically well-flow rates, and the timing of redrilling activities to be critical to the maximization of net returns to the HDR enterprise.

Professor Rausser's discussion examined the role of stochastic optimization techniques in aiding the formulation of resource policy. Such applications have great potential in identifying the costs and benefits of actions designed to generate information and reduce uncertainty. To achieve this potential, however, serious consideration must be given to current specifications, assessment of criteria function, and management's use of natural resource models. In terms of specification, it was argued that multiproduct formulations must be employed which admit both conventional treatments of natural resources products as well as external costs associated with reduced environmental quality from resource exploitation. To assess public intervention, explicit criterion functions must be formulated. Assessment methods were discussed and operational uses of preference theory were outlined. Finally, the major features of readily implementable decision support systems for the evaluation of natural resource management strategies were delineated.

The Farm Food and Nutrition Policy Process: 1978. Leo V. Mayer, chairman (Office of Trade Negotiations), Dale L. Stansbury (Senate Committee on Agriculture, Nutrition, and Forestry), James A. Culver (House Committee on Agriculture), James G. Vertrees (Congressional Budget Office), Allen C. Grommet (House Budget Committee), J. B. Penn (Council of Economic Advisors), Lynn M. Daft (Domestic Policy Staff, White House), Don Paarlberg (Purdue University), and G. Edward Schuh (USDA)
A changing Congress, a cyclical economic downturn in agriculture, and a tightening federal budget were major factors shaping the process of farm food and nutrition policy making in the 1977–78 period, according to members of this symposium. In explaining the actions of the agriculture committees, Culver and Stansbury noted that many senators and half the members of the House of Representatives are new since 1974 and thus have little "sense of history." This relative inexperience perhaps enhances the professional staff influence on members although this varies by commodity and by length of tenure. Grommet went on to observe that budget restraints have had a major influence on Congress although it was not evident in the 1977 Farm Bill deliberations. He explained that the budget process was more effective in 1978 but noted that other institutional changes including consumer influence on newer members were also significant. Vertrees confirmed the relatively small, direct impact of the budget process on the 1977 Farm Act and suggested that building an effective bridge between analyst and policy maker is a continuing challenge. In reviewing the administration of programs, Penn noted that farm protest grew to the point in early 1978 that a presidential veto looked to be the only way out of an extremely disruptive and costly farm bill. He noted that a wide range of governmental agencies with varied interests now participate and influence final decisions on farm programs. Daft followed up by observing that no two-farm program decisions ever follow the same path. This, he concluded, makes decision making as difficult as ever despite the more sophisticated analytical apparatus that exists today. In his comments, Paarlberg suggested that several factors are at work making farm policy development and administration more difficult, including reduced farm representation in Congress, increased pressure by consumer groups, and the expectation of members of Congress that they can play to the special interests while the president will "hold the door" on farm matters. He implied this was more difficult for a president of the same party as the congressional majority. In closing the formal

presentations, Schuh suggested that USDA currently has the resources to create a full farm food and nutrition policy for the nation. He questioned, however, whether a secretary of agriculture can balance such a wide range of interests internally and maintain a strong bargaining position among the wide cast of federal agencies now involved in farm policy decisions. Questions left unanswered included whether foreign effects are adequately accounted for in the policy process, whether too much manipulation of low-priority data clogs up the policy-making process, and whether there is adequate agricultural representation in general fiscal and monetary decision-making bodies in the federal government.

Implications of Policy Changes in Selected Countries for U.S. and Canadian Agriculture. Elmer L. Menzie, chairman (University of Guelph), R. D. Singh (Purdue University), Roger Fox (University of Arizona), and Anthony Tang (Vanderbilt University)
This session focused on issues raised from papers presented earlier on self-sufficiency policies in India, Brazil, and the Peoples Republic of China. Government policies in India have been biased against the rural poor in favor of cheap food for the urban population. Singh questioned the validity of stock figures as a self-sufficiency proxy. Even with 20 million tons of grain stocks many people face starvation.

Policies must be developed to raise incomes and employment opportunities. India should also carry out more research to improve the competitive position and expand exports.

Brazilian agricultural policy focuses on import substitution and export expansion. Fox indicates significant tax reliefs are given to promote exports. Incentives are provided for industries to process raw materials domestically. This has a significant impact in saving foreign exchange earnings and creating employment.

Producer subsidies have been paid in order to become self-sufficient in wheat. The costs of such programs tend to be high and resource-use distorted.

Production of food in China has only been able to keep up with population growth. Tang maintains personal incomes have had little increase and, by rigid rationing, per capita consumption has been maintained at nearly constant levels. China is expected to continue rationing. An expected increase in livestock production will be counterproductive because this is a relatively inefficient way to use scarce grains. China is forced to try to maintain its own grain reserves because it cannot risk a shortfall and dependency on international reserves.

The Internationalization of the U.S. Food and Fiber System through International Capital Flows. Kenneth R. Krause, chairman (ESCS, USDA), George Kruer (Department of Commerce), Harvey Shapiro (Department of the Treasury), Gerald W. Collings (Continental Grain), and Harold Breimyer (University of Missouri)
The U.S. government policy is "to neither promote nor discourage inward or outward investment. This is consistent with our commitment to an open International Economic System." Some states have restrictions on alien investment in agriculture.

Inward direct investment has increased rapidly; at $34.1 billion year-end 1976 it was, however, only about 22% of our outward investment. Our food system and agriculture account for about 20%–25% of the inward investment. U.S. agricultural land is apparently a current favored investment.

Multinational firms make the most of the foreign direct investments and continually evaluate alternatives between countries. They provide important international activities for U.S. agriculture. Most have not invested in agricultural land.

The International Investment Survey Act of 1976 (P.L. 94–472) requires the executive branch to conduct five-year inward and outward investment surveys and analytical studies. Little is known about the magnitude or the structural efficiency or income effects of foreign investment on agriculture.

Policy decisions remain on whether inward investment will be important enough in food and agriculture to require additional federal reporting, analytical studies, and special policies.

Ethics, Resources and Development Theory: New Challenges for Agricultural Economists. Maurice Kelso, chairman (University of Arizona), Roger Fox (University of Arizona), David Brown (University of Tennessee), Glen Johnson (Michigan State University), James R. Simpson (University of Florida)
It now appears that, to a greater extent than ever, decisions about development and resource use will be made in a nonmarket context. In effect, the constraints imposed on research work will continue to embody more and more ethical considerations. The purpose of the symposium was to discuss the meaning of ethical and political considerations and their relation to agricultural economists who may be required to employ them in their research.

Ethical issues in international development were discussed by breaking them into three categories: issues between developed and developing countries, issues fundamentally related to lesser developed countries (LDCs), and issues mainly relating to a worldwide development strategy. It was determined that the agricultural economist has much to offer decision makers working on nonmarket, nonquantifiable, socially set goals because of an analytical background with a positivistic orientation which is combined with seeking alternatives. It was concluded that it is possible for researchers to produce objective normative knowledge. However, such knowledge, like positive knowledge, will always be tentative and subject to modification and disproof.

The discussion focused on the personal as well as macro or overall discipline level. Examples of ethical issues faced by individual agricultural economists in development work were presented in the context of problems faced by: economists associated with development project planning and implementation; development assistance organizations; faculty members of U.S. and Canadian universities; and economists from developed countries recently returned from studies abroad. Some of these issues, as well as more macro ones were tied into relating the terms "development" and "progress" to agricultural economists' roles in analyzing international development problems. It was concluded that the interface of ethical, social, and economic issues cannot be avoided in most roles that agricultural economists are asked to play.

Goals and Policies in Conflict: Preservation of Agricultural Land. W. Arden Colette and David Mulkey, co-chairmen (University of Florida), B. L. Dillman (Clemson University), and Burl Long (Virginia Polytechnic Institute and State University)
Agricultural land is a resource, the allocation of which affects the obtainment of individual, local, state, and national goals. Decision or policies made at one level may inhibit the attainment of goals at other levels. Land allocation among users traditionally has been accomplished by market forces. Efforts to fix the use of land through land preservation legislation is based on the assumption that the market does not reflect adequately the goals and priorities of society. These restrictions on land use would require a major reevaluation of our system of property rights. At present there is no evidence that the market will not adequately allocate land for food production. When the market does not appear to reflect the priorities of society, it would be better to alter the underlying institutions so that the market acts as a better indicator of society's desires rather than impose external restrictions.

Future Participation of Agricultural Economists in Development Assistance. Harold Riley, chairman (Michigan State University), Randy Barker (Cornell University), William Merrill (Iowa State University), and Dale Adams (Ohio State University)
Changes in U.S. foreign assistance programs are being instituted through Title 12 and further reorganization is being considered through administrative and legislative actions. These changes and evolving policies in developing countries and international agencies have important implications for the future participation of U.S. agricultural economists in development assistance. Barker observes a slow but significant expansion in the role of agricultural economists as part of the International Agricultural Research Center system where agricultural technologists are realizing the importance of the assessment of obstacles to the introduction of new technologies and economic analysis of the costs and potential benefits of research activities. Merrill stressed that the demand for well-trained agricultural economists will continue to exceed the supply of those with foreign experience, language competence, and farm backgrounds. Adams, on the other hand, argued that for the past several years there have been almost no opportunities for young professionals to be recruited into regular, tenure stream university positions in the area of international development. Furthermore, he voiced the view that the mix of activities which AID is requesting of U.S. universities does not adequately support the central roles of the university. Subsequent discussion gave emphasis to the frustrations of university professionals who are seeking long-term career opportunities in international development. On the other hand, there was a reminder that U.S. university professionals must be sensitive to the real needs in the less developed countries and the political and institutional constraints surrounding foreign assistance activities.

Emerging Research Issues Directed at Small, Low-Income, Limited Resource Farms. Alfred L. Parks, chairman (Prairie View A&M University), Melvin E. Walker, Jr. (Fort Valley State College), Sammy L. Comer (Tennessee State University), Samuel L. Donald (USDA, Louisiana State University), Leroy Davis (Southern University), and Mack C. Nelson (Prairie View A&M University)
The current resurgence of interest in the plight of the so-called small, low-income, limited resource farm as an economic unit is viewed by many with a great deal of skepticism. This is in spite of the ever-increasing research and extension activity relating to the small farm, or small farm operator. One of the biggest questions seems to be centered around the confusion about whether reference is being made to the small farm or to the small farm operator. It is not quite clear if they are one and the same.

This symposium, among the several issues it addressed, attempted to examine the normal identification and characterization of the small farm. What seems to be quite clear is that most researchers have tended to use gross income as a point-of-departure situation. Whether or not this approach is adequate is debatable. What does seem to be evident, however, is the fact that the full-time small farm operator is declining rapidly in favor of the part-time, small farm operator. This may perhaps change the definition of the small farm operator. The issue of whether the small farm operator can survive may be centered around his management capability and his overall level of efficiency.

A number of alternative options are perhaps available to the small farm operator: (*a*) remain in farming with no expansion in land, but make adjustments in the enterprise mix, (*b*) remain in farming on a full-time basis with expansion by increasing the capital outlay for land and other resources, (*c*) become a part-time farmer combined with off-farm employment, and (*d*) leave farming and either rent or sell the land.

Another key issue centered around the question of whether the problem of the small farm operator is one of production inefficiency or marketing inefficiency. Evidence as to which of these problems is the more serious is inconclusive. However, this issue as perceived by the small farm operators themselves seems to favor marketing as the more serious issue.

A final and perhaps more critical issue seems to be the lack of communication and coordination of efforts by research and extension units. The linkage between researchers and extension personnel is of paramount importance. Serious consideration should perhaps also be given to the opinions of the farmers themselves. Evidence seems to suggest that research activities are not adequately addressing either the issues or the problems.

Food System Economic Research for Energy Policy. Robert D. Reinsel, chairman (ESCS, USDA), Thomas Lutton and Patricia Devlin (ESCS, USDA), and Thomas VanArsdall (Office of Energy, USDA)
The uncertainty over energy supply and escalating energy prices has developed a strong interest in forecasting potential impacts of such supply constraints and rising prices. There has been a need to structure a research effort to evaluate energy concerns from the viewpoint of the farmer, the food processor, the wholesale and retail dealers, and the consumer. To this end, an industrially structured approach is offered. Where data is available, industrial-derived demands for energy are estimated. Otherwise, a simple input-output approach on national industrial energy consumption is postulated.

Reinsel and VanArsdall postulated the overall organization of energy research plans, problems, and current activities being addressed in the ESCS branch of USDA. The purpose of these two talks were to present current ESCS, USDA involvement in the energy area.

Devlin presented an empirical econometric analysis of natural gas consumption in agriculture. Conclusions were that the derived demand function for natural gas was indeed downward sloping, and substitute fuels are available to a limited extent.

Lutton presented a disequilibrium model of interfuel and interfactor substitution pertinent to the food manufacturing industries.

Questions and comments included: (*a*) Q: Has any attempt been made to develop budgets for prototype farms and manufacturing establishments? A: Not yet, but work is in progress; (*b*) Q: To what extent do regional problems concern modelling activities? A: Data limitations preclude all but simplest models.

Supply and Input Choice Response by Multiproduct Firms: New Approaches. Robert D. Weaver, chairman (Pennsylvania State University), C. Richard Shumway and Annie A. Chang (Texas A&M University), and James K. Whittaker (Oregon State University)
Economic theory provides an explicit basis for statistical measurement of choice response. Choice functions derived from marginist theories must be linearly homogeneous in prices and have symmetric cross-derivatives. Furthermore, the characteristics of technology (homotheticity, homogeneity, jointness, separability) are reflected in choice functions through the necessary conditions for optimal choice. Following a definition of "consistent" choice functions (Weaver), Whittaker reviewed the constant elasticity of transformation (C.E.T.) model and reported an application to regional acreage response. Shumway and Chang presented an application to Texas field crop supply emphasizing shifters of the C.E.T. function. Considerable discussion was given to the interpretation and sensitivity to specification of estimating price elasticities. Concluding, Weaver demonstrated a methodology based on duality which derives input and output choice functions from the maintained choice hypothesis that are consistent with any underlying technology (joint in inputs, nonhomethetic, and variable elasticities of transformation or substitution). Discussion focused on the applicability of the methodologies to choices of processing, marketing, and other multiproduct firms. Data requirements and facility of implementation were also reviewed.

Alternative Methods for Valuing Outdoor Recreation. Michael J. Hay, chairman (U.S. Fish and Wildlife Service), Alan Randall (University of Kentucky), J. John Charbonneau (U.S. Fish and Wildlife Service), and Nancy E. Bockstael and Kenneth E. McConnell (University of Rhode Island)
Two approaches to estimating outdoor recreation benefits were presented. Empirical applications were to wildlife-oriented recreation but the methods are applicable to other types of recreation.

Randall described various contingent valuation mechanisms which establish hypothetical markets for nonmarket goods. Values of the goods are estimated by recording the yes/no decisions of individuals confronted with perturbations in the hypothetical market prices. Various possible biases are avoided by careful design and pretesting of the hypothetical markets.

Charbonneau presented a hedonic price-valuation method. Estimates of demand and economic values for recreation characteristics are derived using recreationists' expenditures by first estimating their implicit prices and then using the prices to estimate demand.

McConnell and Bockstael discussed the methods. Iterative bidding games, as opposed to noniterative direct questions, were the most promising hypothetical market approach. The application of the hedonic method required restrictive assumptions, casting doubt on the empirical results.

Crop Response to Irrigation: A State-of-the-Arts As-

sessment of What is Known and Practiced. Harry W. Ayer, chairman (NRED, USDA), Gerald Arkin (Texas A&M University), Glenn Hoffman (U.S. Salinity Laboratory, Riverside, California), and Marvin Jensen (Snake River Conservation Research Center, Kimberly, Idaho)

A state-of-the-arts assessment was made of (*a*) research on crop response to water quantity, (*b*) research on crop response to water quality, (*c*) the technology used and information provided by irrigation management services (both public and private), and (*d*) economic modeling of irrigation systems.

Dr. Gerald Arkin focused on the state-of-the-arts of research on crop response to the amount of water applied. Of special interest was the effect of irrigation timing, soil type, and climatic conditions which affect water-yield functions.

Dr. Glenn Hoffman assessed the research on salinity-yield relationship and many of the climatic-soil-crop factors which affect this relationship.

Dr. Marvin Jensen surveyed most of the private and public irrigation service firms and organizations to learn of current practices in the United States. His discussion focused on the state-of-the-arts of technology currently used by irrigation management services and the information they provide.

Dr. Harry Ayer described the most current economic models of irrigation. Topics discussed were (*a*) the accuracy of economic water-crop response models, (*b*) risk and uncertainty in irrigation decisions, (*c*) types of model employed, and (*d*) applicability of models at the farm and government planning agency levels.

Economic Statistics Committee Task Forces: Reports of Findings. Gaylord Worden, chairman (Office of Federal Statistical Policy and Standards), Bruce Bullock (Farmbank Services), Bruce Gardner (Texas A&M University), Thomas Miller (ESCS, USDA), and Earl Swanson (University of Illinois)

This symposium focused on progress and preliminary findings of two task forces organized by the Economic Statistics Committee of AAEA. One task force is studying the economic value of statistical information. This study is looking at a broad statement of the problem, evaluating previous studies of this type, and designing steps, such as a seminar for advancing the state of knowledge in this area. A particular focus of the task force is the need for a basic theory to use in addressing the problem.

The second task force is studying problems in the measurement of agricultural productivity. The task group has looked at a wide variety of issues related to conceptual problems, measurement problems, data gaps, index number problems, and stock/flow problems in the USDA calculations of agricultural productivity.

The Impact of Policy Changes in Transfer Payment Programs on Individuals. E. Evan Brown, chairman (University of Georgia), Nancy Vrechek Hill (University of Georgia), Leslie Whitener Smith and Gene Rowe (ESCS, USDA), Joachim G. Elterich (University of Delaware), Robert G. Williams (Mathematica Policy Research), Howard F. Robinson (North Carolina Agricultural and Technical University), and Wesley Musser (University of Georgia)

Literature review indicated that transfer payments in the 1979 federal budget will total $214 billion or about 43% of the total. Transfer payments to individuals are carried out by hundreds of programs. Four of these programs were discussed. The Food Stamp Program and its effect on hired farmworker families was redesigned in 1978 to increase the participation of the most economically disadvantaged. The impact of the 1977 legislation on this group was examined. The Unemployment Compensation Amendment of 1976 is expected to provide income protection for about 40% of all hired agricultural workers, with benefits averaging 14% of average annual earnings. About one-fourth of unemployed farm workers are expected to exhaust benefits before finding new jobs. Experiments with the Aid to Families with Dependent Children Program has increased program responsiveness while reducing aggregate assistance costs. Major income maintenance schemes and the current proposed welfare reform plans were analyzed. Conclusions on the economic and political feasibility of guaranteed annual income experiments in six states were presented.

Farmer Discontent: The American Agriculture Movement; Current Status of Farmers; and the Role of Extension Agricultural Economist. James D. Shaffer, moderator (Michigan State University)

This was a symposium without formal presentations. More than fourteen people participated actively in the discussion which continued beyond the time limit. The symposium with no formal speakers "worked."

A few of the comments from the discussion follow. The status of farmers varies greatly. The discontent tended to be greatest where farming is most risky and among farmers who were financially over-extended. The leaders of the American Agricultural Movement tended to be wealthy. Appreciation of land is central to the evaluation of farmer status and to programs to deal with farmer income supports. Most policymakers and agricultural economists did not take the American Agricultural Movement proposal for a farmer-controlled marketing board seriously. The discontent provided a teachable moment for the general public and extension economists responded. Confrontation meetings were generally unproductive.

Global Climatic Change to the Year 2000, and Implications for Agriculture. Joseph W. Willett, chairman (ESCS, USDA), William R. Gasser (ESCS, USDA), Louis M. Thompson (Iowa State University), and D. Gale Johnson (University of Chicago)

Results of a study conducted jointly by the National Defense University, USDA, Defense Advanced Research Projects Agency, NOAA, and the Institute for the Future. Subjective probabilities for the occurrence of specified climatic events were elicited by a survey of twenty-four climatologists from seven countries. Their responses were aggregated to construct five possible climate scenarios for the year 2000, each having a "probability" of occurrence as judged by the experts.

A second panel of agricultural experts were surveyed to obtain estimates of the effect on specified crop yields in designated countries of changes in weather variables. For each crop region a bivariate normal distribution of temperature and precipitation variables was estimated. These distributions were combined with the results of the agriculturalists' yield estimates to derive estimates of the impact of climate changes on yields.

The yield estimates were expanded to encompass a high proportion of the world's grain production. These yield patterns were examined using a world grain, oil, livestock model developed by the Foreign Demand and Competition Divison, ESCS, USDA. The effects of yield variations on world food production, trade and price patterns, and policy implications are being examined.

Setting Priorities in Agricultural Economics Research. Paul W. Barkley, chairman (Washington State University), John W. Malone (Pennsylvania State University), James Nielson (SEA-USDA), Kenneth D. McIntosh (University of West Virginia), and Daniel W. Bromley (University of Wisconsin)
This session was organized in response to a number of requests that the AAEA, as an association of professionals, develop, maintain, and publish an ongoing list of high priority research themes. Malone, speaking as a department chairman, suggested that individual researchers are in the best position to establish priorities, but they must continue to be attuned to the public interest, scientific needs, and the additivity of research. Nielson commented on USDA's priority-setting process indicating that in periods of tight budgets, research becomes shorter in range and those activities with a high chance of success are funded.

McIntosh took an affirmative position saying that AAEA should set priorities. The priority list would be a selective good available to members and would add to their stock of information about the real world. Bromley took the opposing view and argued that the association would foster mediocrity and unwittingly put itself in the role of kingmaker if it were to establish and publish research priorities. Floor discussion centered on the apparent schism between priorities related to grant availability and priorities related to public interest and public need. Some sharpening of the priority question is warranted.

Contributed Papers

Agricultural Programs and Policy (Milton Hallberg, Pennsylvania State University, Chairman)

"Optimal Control Techniques for Agricultural Policy Analysis: An Application." James W. Richardson (Texas A&M University) and Daryll E. Ray (Oklahoma State University)
Optimal values for the loan rate and acreage set-aside levels of corn, wheat, and cotton are determined for a price and income support farm program with a voluntary set-aside provision. The optimal values are estimated using the Optimal Control Theory Option in the National Agricultural Policy Simulator (POLYSIM).

"The Social Costs of Instability in the U.S. Wheat Industry." Gerald E. Plato, Richard G. Heifner, and John W. Murray (NEAD, ESCS, USDA).
This paper examines the social welfare losses from instabilities in the U.S. wheat market during the 1972–77 period. The supply curve shift due to fluctuations in producer returns plus the deviations about market equilibrium due to price, yield, and acreage fluctuations are used in evaluating the social welfare losses.

"Impacts of Price Stabilization and Income Policy." William Lin (NEAD, ESCS, USDA) and Ann Ingerson (Oxford University)
The short-term impacts of 100% parity farm prices on total farm numbers are minor. Price stabilization program tends to increase total farm numbers and to redistribute farms from the higher sales classes to lower sales classes, increase real cash receipts per farm, and mitigate the market concentration in the farm sector.

"Intercommodity Effects of Government Programs." C. Stassen Thompson (Clemson University) and Bruce R. Beattie (Texas A&M University)
Evaluation of agricultural programs in a partial equilibrium framework is sufficient for the general case. However, an intercommodity framework is necessary if pecuniary and technological externalities are to be considered. Application of the intercommodity framework to the barley program revealed an intercommodity cost of $23 million.

"Indirect Costs of Peanut Control Programs." R. McFall Lamm, Jr. (CED, ESCS, USDA)
An annual econometric model is used to measure the indirect costs of partial government controls for the domestic peanut industry. Results indicate that the costs of controls to consumers of peanut products totaled $6.98 billion (in 1976 dollars) from 1935 to 1976.

Institutions and Regulations (Darrell Hueth, University of Rhode Island, Chairman)

"Measurement of Economic Benefits for Potential Public Goods." Ian Hardie and Ivar Strand (University of Maryland)
Willingness-to-pay values for potential government goods, as they are presently estimated, are not consistent with the definition of willingness-to-pay developed in the theory of public expenditures. The differences are explored and an alternative technique is presented. Limited results indicate the alternative technique has potential for reducing the differences.

"Use of Industrial Development Bond Issues in Acquisition of Long-Term Debt Capital by Selected Farmer Cooperatives." Donald R. Davidson (CMD, ESCS, USDA)
Study delineated experiences of subject cooperatives using industrial development bonds for long-term debt capital. Cooperatives opted for "revenue" bonds instead of "general obligation" issues. ID bond financing showed sharp rise during 1970s, with number of bond-financed projects increasing threefold and size of issues 45% over 1960s.

"Effective Rate Minimization in Cooperative Finance." Ken D. Duft (Washington State University)
The recent incorporation of large new cooperative borrowers into the U.S. Banks for Cooperatives system has impacted the desired equilibrium of debt to equity capital. Capital program adjustments designed to reestablish equity levels have been implemented without the lenders' determination of their impact on effective interest rates. Such rates are minimized where the capital revolve period coincides with the length of time required to fully capitalize the new borrowers.

"Adjustment of the School Lunch Commodity Reimbursement Rate." Thomas A. Stucker, William T. Boehm, and Walter Epps (NEAD, ESCS, USDA)
Government commodity donations to schools are now adjusted using the consumer price index. In this study, wholesale price indexes were developed which could adjust the "reimbursement rate" to more accurately reflect changes in the value of commodities distributed. This would better achieve the objective of maintaining benefit value over time.

"The Behavior of South African Agricultural Marketing Boards (1950–74)." David Rees (University of Cape Town)
The behavior of agricultural marketing boards in South Africa is examined. The system's structure is

described and major economic variables under control of the various boards examined. Though there are significant differences in behavior among the various boards, in several instances the policies of the boards have been neutral. The explanation for this behavior is to be found in the political constraints on the power of the boards.

Taxes and Agriculture (Martin K. Christiansen, University of Minnesota, Chairman)

"Tax and Inflation Adjustments to Machinery Cost Models." Myles J. Watts and Glenn A. Helmers (University of Nebraska)
Expressions of cost for a farm machine are developed on a real and nominal basis by both traditional and capital budgeting. Income tax aspects as well as inflation influences are incorporated in the capital budgeting estimates. Modifications of the traditional budgeting method to account for inflation are demonstrated.

"Impact of Investment Tax Credit on Farm Firm Growth." Wesley N. Musser, Donald W. Reid (University of Georgia), and Neil R. Martin, Jr. (Auburn University)
This paper reviewed the theory of capital budgeting in a reference to the investment tax credit, developed a method of incorporating investment tax credits into a multiperiod mathematical programming model of firm growth, and presented on empirical application to a representative farm in the Georgia Piedmont.

"Estimating the Progressivity of Farm Tax Credits for Alternative Circuit-Breaker Formulas." Marvin B. Johnson and Caryn E. Wirth (University of Wisconsin)
Michigan and Wisconsin base their farm tax relief programs on the circuit-breaker principle, but use different tax credit formulas. Income and property tax data on a sample of Wisconsin farmers are used to compare the impact of the two formulas on the progressivity of the property tax for farmers.

"Tax Loss Farming: Extent, Impact, and Reform for a Perennial Problem." Hoy F. Carman (University of California)
Tax loss farming, the target of tax reform efforts for over a decade, still exists. This paper attempts briefly to summarize evidence on the extent of tax shelter agricultural investments by nonfarm investors, the economic impact of tax loss farming, and tax reform efforts.

"The Tax Reform Act of 1976: Analysis of the Implications for Estate Planning." Clint E. Roush, Harry P. Mapp, Jr., and Cecil D. Maynard (Oklahoma State University)
The Tax Reform Act of 1976 implemented major changes in federal estate and gift tax laws. The potential impact of the new law on lifetime gift and at-death transfer strategies is analyzed for farm firms. Estate transfer costs and the present value of transfers under the old and new laws are compared.

International Trade of Agricultural Commodities (Amalia Vellianitis-Fidas, ESCS, USDA, Chairperson)

"Effects of the European Community's Agricultural Policy on International Trade in Grains." Emilio Pagoulatos (University of Missouri), David Debertin and Angelos Pagoulatos (University of Kentucky)
A simultaneous econometric model of the European Community's grains sector consisting of thirty stochastic equations and five identities is specified and estimated via 3SLS. Simulation with the model evaluates the quantitative impact of the "variable levy" system of protection on production, consumption, and EEC trade in grains.

"Joint Products and the Impact of a Tariff: The Case of Soybean Meal in West Germany." Philip L. Paarlberg (FDCD, ESCS, USDA) and Robert L. Thompson (Purdue University)
Analysis demonstrates that an import tariff on a joint product may lower the world price of the product sufficiently that the domestic price also declines. That excess supply elasticities are important determinants of the net effect is illustrated by the case of a hypothetical tariff on soymeal imports in West Germany.

"Estimating the Influence of External Forces on the Domestic Market: An Alternative Approach." Gary W. Williams and Robert L. Thompson (Purdue University)
Direct estimation of export and import demand schedules to account for foreign market impacts on domestic markets is compared with estimation of a family of simultaneous country market or regional models linked by trade flows. A three-region world soybean and product trade model which employs this method is discussed.

"Optimal Control of U.S. Wheat Storage and Export." Won W. Koo and Oscar R. Burt (Montana State University)
A dynamic programming model applied to Markov Chain process was used to develop empirical economic decision rules for the U.S. wheat exports as a function of wheat price and stocks under domestic and world welfare criteria. The maximization of expected net social benefits is the objective function of the model. The paremeters were estimated on the basis of empirical estimates of a U.S. wheat acreage, yield, demand, and price equations.

"An Evaluation of Buffer Stocks: The Case of Rice in Colombia." Anne Marie del Castillo (FAS, USDA)
This study measures the magnitude, type, and dis-

tribution of the benefits and the costs of a stockpiling program in a developing economy. Emphasis is placed on the trade policy implications. Reutlinger's stochastic simulation model was used in the analysis.

Beef and Pork Markets (Walter Haessel, Pennsylvania State University, Chairman)

"Destabilizing Effects of Basis Variability on Production Hedging Revenues for Feeder Cattle." Barry W. Bobst and Joe T. Davis (University of Kentucky)
This paper presents evidence that basis variability causes short-run revenue variance of feeder cattle hedges to exceed corresponding cash price variance. These results indicate an imperfection in the feeder cattle futures market and indicate that across-contract measures of hedging performance underestimate the variability that is actually encountered.

"Weight, Sex, and Feeder Cattle Price Differentials: A Theoretical and Empirical Analysis." Steven T. Buccola (Virginia Polytechnic Institute and State University)
A model is developed which helps explain the impact of weight, sex, breed, and other animal characteristics on feeder cattle prices. Theoretical results are then compared with weight- and sex-price differentials observed over two cattle cycles. The influence of feed and fed cattle prices on these differentials is emphasized.

"An Empirical Model of the Basis for Live Beef Cattle." Raymond M. Leuthold (University of Illinois)
A model designed to explain the basis for live beef cattle is developed and tested. Fundamental arguments demonstrate that the basis for cattle reflects the expected change in cash price over time, mostly caused by shifts in supply. Economic variables generally significant and of expected significance are current slaughter levels, number of cattle on feed, beef-corn price ratio, price of feeder steers, and cash price of fat cattle.

"Estimating Aggregate Cattle on Feed Placement Weights and Growth Rates." James N. Trapp (Oklahoma State University)
Optimal control techniques are used to estimate aggregate cattle on feed placement weight and growth characteristics. The use of optimal control techniques to scientifically estimate these characteristics and its potential to estimate other unreported data series permits more information and new approaches to be used in forecasting beef supplies.

"Causal Relationships between Live Hog Cash and Futures Prices." Steve Miller (Clemson University) and David Kenyon (Virginia Polytechnic Institute and State University)
The role of the live hog futures market in the live hog cash price formation process is investigated. A test of the proposition that the futures market has played such a role is made by assessing the causal relationships between daily cash and futures prices. Test results support this proposition.

Theory of the Farm Firm (Larry Connor, Michigan State University, Chairman)

"Sensitivity of Efficiency Frontiers Developed for Farm Enterprise Choice Decisions." Bryan W. Schurle (Kansas State University) and Bernard L. Erven (Ohio State University)
The sensitivity of efficiency frontiers derived for farm enterprise choice under risk is examined. With expected return levels held constant, substantial enterprise combination differences were found between optimal and near optimal solutions. However, there was relatively little additional risk associated with these near-optimal enterprise combinations.

"A Methodology for Durable Asset Replacement Decision Making." Alan E. Baquet (Oklahoma State University)
Durable asset replacement theory typically assumes (*a*) a constant conversion rate between the stock of the asset and its flow of services, and (*b*) perfectly substitutable services from either asset. A methodology is presented that relaxes both assumptions. This permits a more accurate description of the replacement process. The variable usage rate for the asset becomes an important determinant of replacement.

"Combining Lumpy and Divisible Assets under Uncertainty." Lindon J. Robison and J. Roy Black (Michigan State University)
This paper develops decision rules for combining divisible assets with lumpy-fixed assets that generate stochastic services. The decision rules differ depending on the decision maker's risk aversion. The theoretical results are illustrated with a practical problem which alternatively assumes the decision maker is a profit maximizer under certainty, and expected profit maximizer, or an expected utility maximizer.

"Determining Optimal Fertilization Rates under Variable Weather and Price Conditions: An Extension." C. Robert Taylor and Hovav Talpaz (Texas A&M University)
This paper presents a theoretical framework for determining optimal fertilization rates under risk aversion. Three sources of risk were incorporated into the model: (*a*) the influence of weather, (*b*) uncertainty about the coefficiency of the response

function, and (*c*) product price variability. The model is applied to grain sorghum in the Texas Blackland Prairie.

"Testing for Allocative Efficiency When Production Coefficients Are Random." J. F. O'Connor (University of Iowa) and M. G. Van Der Veen (International Agricultural Development Service)
This paper considers the efficient allocation of resources when the production function has random production elasticities. Conditions for allocative efficiency are given for anticipated profit maximization and also for expected profit maximization. Procedures for testing of hypotheses about resource allocation are given. An example using data on rice production in the Philippines is presented.

Managing Large and Small Farms (Leroy Davis, Southern University, Chairman)

"A Farm Level Financial Analysis of Alternative Soil Loss Control Policies." William G. Boggess, James M. McGrann, Earl O. Heady, and Michael Boehlje (Iowa State University)
A farm firm level model is used to analyze the impacts of alternative soil loss control policies. Adjustments in farm management practices required by the alternative control policies are discussed. In addition, the analysis investigates the impacts of soil loss controls on farm financial characteristics including income generation, cash flows, asset values, and debt servicing capacity.

"Growth, Income, and Survivorship Relationships in Wheat Farming." Larry J. Held (University of Wyoming) and Glenn A. Helmers (University of Nebraska)
A financial simulation model was developed for a Nebraska Panhandle wheat-fallow farm. The influence of four land expansion alternatives on firm growth, income, and survivorship, as well as the effect of alternative internal borrowing on a land purchase option, were examined. Share renting was found to increase survivorship while only slightly reducing growth. A trade-off between survival and growth or income occurred as the internal borrowing limit was changed.

"Analysis of Field Scouting and Insecticide Use." Arthur Grube and Gerald Carlson (North Carolina State University)
The use of field scouting and insecticide use on Delta cotton farms was investigated. It was found that management and incremental value of scouting increased adoption of scouting. Scouting was not found to be a substitute for insecticide use on these farms. Scouting had a strong effect in increasing the value of the cotton produced.

"The Economics of an 'On-the-Farm' Wet Plant Fractionation System." Harlan Hughes (Michigan State University) and Tom McGuckin (University of Wisconsin)
Wisconsin researchers have developed a "wet plant fractionation" (WPF) system to separate protein and fiberous material of alfalfa. The net income of the WRF system was compared to the traditional low moisture silage system. The investment value of this new technology was estimated at $31,736 to $54,920.

"A Perspective on Small Farm Research." James E. Lewis (NRED, ESCS, USDA) and Peter M. Emerson (NRCD, CBO)
Arguments presented by small farm advocates are outlined. The authors present a national level profile of the small farm population, state some implications of the data and small farm literature, identify some transitions taking place in farming and rural communities, and present some suggestions on issues which researchers might address. Microeconomic analysis of the small farm sector is felt to be an inadequate approach to realistic evaluation of small farm issues.

Farm Land, Labor, Capital, and Management (T. Kelley White, Purdue University, Chairman)

"Forecasting Farmland Prices: A Comparison of Econometric and Time Series Methods." Randall Kramer, Rulon Pope, Richard Green, and B. Delworth Gardner (University of California)
Previously published empirical models of U.S. farmland prices are reviewed and reestimated including recent data. Structural changes have occurred. A simple single equation econometric model with less economic structure appears to forecast better than a simultaneous equation model. Box-Jenkins forecasts are roughly as good as those based upon a simultaneous equation econometric model, but somewhat inferior to the single equation model.

"Off-Farm Work by Farmers: Theory and Results for Canada for 1971." Ray D. Bollman (Statistics Canada)
The concept of a kinked demand-for-labor curve is developed to analyze the phenomenon of off-farm work by farmers. The implications of this concept for studies in the agricultural sector are presented. Results of a linear, probit, and logit probability response model to explain the probability of an operator participating in off-farm work are presented and the implications of the results are discussed.

"Financial Analysis and Credit Management in Agriculture." Peter J. Barry (Texas A&M University)
Principles and procedures of farm loan analysis are reviewed and a case farm analysis with monthly

financial statements is used to evaluate effects of seasonality, lengthy production, and marketing policies on credit use, financial risk, and quality of farm collateral including collateral provided by operating inputs.

"Market Expectations and the Term Structure of Interest Rates." David A. Lins (USDA, University of Illinois) and Robert G. Aukes (University of Illinois)
Direct and indirect measures of interest rate expectations are used to measure the term structure of agriculturally related interest rates. Indirect measures of expectations support the expectations hypothesis of the term structure relationship while direct measures (interest rate futures markets) do not. Reasons for this discrepancy are explored.

"Youth Extension Programs: A Joint Business and Land Grant University Approach." Steven K. Riggins (University of Kentucky)
This paper reports on a joint business-Agricultural Economics Department extension program for youth carried out by the University of Kentucky and the Kentucky Council of Cooperatives. This paper concludes that the benefits to the department easily exceed the effort required and that relevant joint programs are alive and well.

Optimizing Models: On Land and in the Water (Debbie Walden, NRED, ESCS, USDA, Chairperson)

"Land Application of Sewage Sludge: An Application of Multiple Objective Methods." Robert D. Perlack and Cleve E. Willis (University of Massachusetts)
Public decision processes are often hampered by a failure to focus on more than a single objective. The multiple objective application reported here may facilitate sound decisions on alternatives currently being selected for disposal of metropolitan Boston's sewage sludge. The generating method for searching noninferior solutions has far wider applicability.

"A Spatial Equilbrium Analysis of the Impact on the Canadian Rapeseed Industry from Changes in Transport and Tariff Rates." W. H. Furtan, J. G. Nagy, and G. G. Storey (University of Saskatchewan)
This paper presents a four-region, three-commodity, spatial equilibrium, quadratic programming model of the world rapeseed industry for the year 1974. The model allows for processing and examines the effects on prices and trade flows of rapeseed, rapeseed oil, and rapeseed meal from changes in transport and tariff charges.

"A Solution Procedure for the Modified Stollsteimer Model." Stephen W. Fuller and Robert L. Sielken (Texas A&M University)
Chern and Polopolus modified the original Stollsteimer model with the introduction of a discontinuous plant cost function. This paper relates an efficient solution procedure for this model. The developed procedure can yield a lower cost solution than the method advanced by Chern and Polopolus.

"Sport and Commercial Fishing Interactions: An Optimal Control Model with Implications for Policy and Research." Richard C. Bishop and Karl Samples (University of Wisconsin)
A recreational sector is added to a standard commercial fishing model to identify public decision variables which are important in dealing with sport-commercial conflicts. Shortcomings of current economic inputs to policy making are identified and future research topics to remedy this are derived from the model.

"Economic Evaluation of the Shrimp Discard Problem in Pamlico South, North Carolina." James Waters, James Easley, and Leon E. Danielson (North Carolina State University)
In North Carolina, precommercial-size pink shrimp are incidentally landed, killed, and discarded during harvest of brown shrimp. This study analyzed the incidental catch (discard) problem and managment policies to protect pink shrimp. Results showed incidental catch does not generally reduce fishermen's net incomes sufficiently to adopt a discard abatement policy.

Value of Natural Resources (Katherine Zeimetz, NRED, ESCS, USDA, Chairperson)

"Land Use Policy Issues for the Urban-Rural Fringe." Linda Lee (NRED, ESCS, USDA)
Major policy issues in the conversion of agricultural land to urban use are reviewed, including scope, level, criteria, time, and means. A case history of land conversion in Urbandale, Iowa, is presented as a representative of a class of rapidly growing suburban communities. The experience of this community is used to discuss implications for land use policy in the urban-rural fringe.

"Erosion Control: Costs and Income Distribution under Regulation, Tax, and Subsidy." D. Lynn Forster (Ohio State University) and Gary S. Becker (U.S. Environmental Protection Agency)
The net economic impacts of restrictions on soil loss, taxes on soil loss, and subsidies for lessening soil loss are analyzed. Also, the impacts of these strategies on income distribution are investigated. Net economic impacts are nearly the same under the three strategies, but the income distribution differs substantially.

"Heirs' Property and Rural Development: An Exploratory Empirical Assessment." Gloria Brommel Tinubu and James Hite (Clemson University)
"Heirs' property" refers to real estate passed from one generation to another without administration and/or probate. Exploratory research in South

Carolina suggests that such land tenure arrangements are common among both whites and blacks and among various areas. Preliminary evidence suggests that the uncertainty associated with these arrangements may be a major impediment to economic development programs in many rural areas.

"Environmental Values and the Optimum Rotation Problem in Forestry Economics." Dũng Nguyen (University of Maryland)
The model shows that, even for a forest that provides environmental services, it is always optimal to harvest, and the optimum harvesting age must be somewhere on the rising portion of the growth curve. Furthermore, an analysis based on the economist's criteria would not necessarily result in a much shorter cutting age compared to the forester's optimum.

"Some Further Explorations in Contingent Valuation: The Value of Wildlife-Related Amenities." John R. Stoll, Alan Randall (University of Kentucky), and David S. Brookshire (University of Wyoming)
Contingent valuation techniques were applied to wildlife-related amenities using an iterative bidding approach which permitted testing for several types of potential bias and rigorous interpretation of value data in terms of Hicksian welfare change measures. Contingent valuation formats are evaluated for effectiveness and estimates of activity, option, and preservation values are presented.

Consumer Demand for Farm Products (Fredericka A. Bunting, ESCS, USDA, Chairperson)

"Estimates of Consumer Loss Due to Monopoly in the U.S. Food Manufacturing Industries." Russell C. Parker (University of Wisconsin) and John M. Connor (ESCS, USDA)
Three independent methodological approaches and data sets, two of them new, are used. They include the oft-quoted Scherer estimate applied to food, census price-cost margins, and manufacturer brand-private label price differentials. The conservative estimates, all near $15 billion for 1975, are considered highly significant for public policy.

"The Effects of Socioeconomic and Psychological Variables on Types of Fruits and Vegetables Consumed." David W. Price, Dorothy Z. Price, and Donald A. West (Washington State University)
A factor analysis results in groups of fruits and vegetables that are similar in taste, texture, etc. Liquid assets significantly affect consumption for many fruits and vegetables. Traditional homemakers serve fewer fruit and vegetable items. Basic psychological need levels of the homemaker significantly affect consumption of certain fruits and vegetables.

"Estimating Equivalent Scales for Food Expenditures." C. L. Huang and Robert Raunikar (University of Georgia)
The equivalent scales (based on data from a survey of households in Griffin, Georgia) were estimated to show the effects of age, sex, and household size upon food expenditures. The empirical results indicate that the cost of feeding a child is about 70% that of feeding an adult and there are economies of household size in family food expenditures.

"A Comparison of Alternative Functional Forms for Estimating Household Engel Curves." Larry E. Salathe (NEAD, ESCS, USDA)
A comparison of functional forms commonly used to estimate Engel relationships indicates that income elasticities may vary by more than 50% depending on the choice of the functional form. The inverse and log inverse provided income elasticities that were extremely small and poor statistical fits to the data.

"The Measurement of Structural Variation over Time: The Case for Advertising and FCOJ Demand." R. W. Ward and L. H. Myers (University of Florida)
A distributed lagged advertising model with coefficients having random and systematic adjustments was estimated. The paths of parameter adjustments clearly identify structural changes in advertising effectiveness and price responsiveness. The model is used to show improvements over fixed models for forecasting.

Crop Markets (Annie Yuen, University of Wisconsin, Chairperson)

"Split Demand Analysis for Seasonal Production—The Case of Florida Potatoes." George B. Wall (University of Florida)
A simultaneous equation model was developed to measure seasonal demand for Florida-produced potatoes. In place of dummy variables to separate seasonal effects, the data were separated by seasons and the model applied to both data subsets. Restrictions were placed between like parameters to test the null hypothesis of no seasonal effects.

"Is Production for 'Market Windows' a Viable Alternative for Limited Resource Farmers?" W. Arden Colette and G. Brian Wall (University of Florida)
Fresh-market vegetable production has been advocated as a means of improving incomes of small farmers in northern Florida and southern Georgia. The role of price variability, price flexibility, and income elasticities in improving price expectations and evaluating crop selection is discussed. These concepts are applied to the analysis of potential "market windows" for area growers.

"Minimum Risk Preharvest Sales of Soybeans." Richard G. Heifner (ESCS, USDA)

The formula developed by McKinnon for determining minimum risk, forward selling levels for crop producers operating under yield risk is modified so that basis risk can also be taken into account. Example results are presented for soybeans in nine Corn Belt counties using both the modified McKinnon method and an alternative method involving the direct minimization of variance of return.

"Alternative Models for Evaluating Factors Affecting Productivity in Fruit and Vegetable-Processing Industries." Tom Clevenger (New Mexico State University) and Don Blaney (University of Idaho)
Traditional measures of profitability, market power, new capital expenditures, staff employment, and changes in the gross national product are evaluated in an assessment of factors affecting productivity in five fruit- and vegetable-processing industries. Only the price-cost margin measure of profitability was significant in all industries. The possibility of simultaneity between the market performance measures of productivity and profitability was investigated and found to be invalid for these industries.

"A Variance Component Approach to Industry Cost Analysis." Richard L. Kilmer and Daniel S. Tilley (University of Florida)
A variance component model is used to analyze industry costs. The model quantifies the effect of capacity entrepreneurial ability, plant-operating characteristics, and physical plant variables on average citrus-packing costs. The citrus packinghouse industry was found to have significant potential for the improvement in technical efficiency.

Supply of Farm Products (G. T. Dowdy, Tuskegee Institute, Chairman)

"Nonstochastic Difference Equations, Distributed Lags, and Agricultural Supply." Oscar R. Burt (Montana State University)
Nonstochastic difference equations are introduced as model for describing the dynamics of agricultural supply response, and their rather natural evolution from the theory of distributed lag behavior is illustrated. A practical algorithm for calculating least squares (maximum likelihood) estimates of the parameters is outlined.

"The Role of Education on Saskatchewan Grain Farms." O. L. Henry and W. H. Furtan (University of Saskatchewan)
The productivity of Saskatchewan farms is closely tied to the farmer's educational level and the number of acres farmed. The spouse's education is also an important input into the production process.

"An Economic Model of Livestock Production: A Reconstuction." Robert W. Jolly (Agriculture Canada)
An economic model of livestock production based on control theory is presented. This model can be used to examine both the specification of the technical relationships governing livestock production and the management of the production processes. An application of the model to beef cattle feeding is briefly outlined.

"Modeling Short-Run Beef Supply Response." Enrique Ospina and C. Richard Shumway (Texas A&M University)
Conceptual problems in model specification of beef supply response studies are investigated resulting in the formulation of a simultaneous equation model to estimate annual U.S. carcass supply, demand, and inventories of beef. Three basic issues are addressed: (*a*) disaggregation, (*b*) simultaneity, and (*c*) differentiation between current and expected prices. Selected empirical results are presented.

"Economic Impacts of Large-Scale Organic Food Production." Robert C. Oelhaf (Kimberton Farms School)
Estimates based on a survey of commercial-scale organic farms are presented for increased cost from a large-scale changeover to organic farming. For major crops, land requirements might increase about 10%, labor about 20%, and total costs about 10%, assuming constant returns as organic farming expands.

Crop Yields: How Do We Describe and Explain Them (Odell Walker, Oklahoma State University, Chairman)

"Are Crop Yields Cyclical?" Karen Liu and Austin Fox (NEAD, ESCS, USDA)
This paper shows how spectral analysis can be used to determine the cyclical nature of crop yields. The number and length of cycles are estimated for corn and wheat in the Corn Belt and the Northern Plains. Several cycles appear to be superimposed over the trend yield.

"Are Yearly Variations in Crop Yields for 1960–75 Really Random?" Kuang-hsing T. Lin (Fort Valley State College)
This study examines the leveling of U.S. crop yields in recent decades by testing the validity of randomness hypothesis about individual yield series. Results show significant rising trends for peanuts, potatoes, sugarbeets, and sweet potatoes, significant cycles for barley, peanuts, rice, and wheat, with the remaining twelve crops significantly random.

"The Effect of Distortions in Relative Prices on Corn Productivity: A Cross-Country Study." David C. Lyons and Robert L. Thompson (Purdue University)
Pooled data from fourteen large corn-producing countries for thirteen years show that the corn-

nitrogen price ratio, as well as physical factors and technology, account for a significant part of corn yield differences among countries. Policies which distort corn and fertilizer prices have a significant effect on corn yields.

"An Econometric Yield Response and Forecasting Model for Corn in Indiana." Richard M. Klemme, Marshall A. Martin (Purdue University), and James K. Whittaker (Oregon State University)
Economic benefits can accrue from more timely crop forecasts. An econometric corn yield response model for Indiana that can generate more frequent forecasts was specified and estimated. The model's yield forecasting capability was comparable, and in some cases superior, to that of the U.S. Statistical Reporting Service.

"An Alternate Approach to Measure Technological Progress in Yield." John R. Groenewegen (University of Minnesota)
A model of technological progress in yields is developed which specifies that investment, a function of price and price risk, determines technological progress. A hybridized spline function is employed to model this phenomenon. The statistical results suggest that this approach is superior to using trend variables. The model implies significant increases in yield result from government price support programs.

Transportation by Train, Barge, and Truck (Debbie Pollock, Office of Management and Budget, Executive Office of the President, Chairperson)

"An Evaluation of Seasonal Railroad Rates for the Oklahoma Wheat Transportation Market." Marc A. Johnson (North Carolina State University) and James C. Shouse (Union Pacific Railroad Company)
Harvest-period railroad rate surcharges are applied to a model of the Oklahoma wheat transportation market to test effects of seasonal rail rates upon railroad, truck, and truck-barge modes of transport; shippers; construction; and use of country elevators and farm storage facilities; wheat flows through terminal elevator locations; and the integrity of the rail transit rate of structure.

"An Economic Analysis of Rail Abandonment in Central and Southwestern Ohio Grain-Producing Areas." Donald W. Larson (Ohio State University) and Michael D. Kane (Landmark Cooperative)
The possible impact of rail line abandonment upon grain transportation in central and southwestern Ohio is examined through network modeling and analysis with the Fulkerson Out-of-Kilter Algorithm. Rail abandonment has little impact upon the aggregate total costs of grain transfer; however, considerable changes occur in grain flow, storage, and transport throughout the region.

"The Effect of User Charges on Barge Wheat Movements on the Mississippi River System." James K. Binkley (Purdue University)
This paper reports on a linear programming transhipment analysis of the effect of user charges on Mississippi River System barge wheat shipments. The effect of charges depends upon how waterway costs are calculated and varies by geographic region. Some policy considerations are presented.

"The Impact of Water Transport on the Oklahoma Economy." James C. Chang (Texas Energy Advisory Council) and Daniel D. Badger (Oklahoma State University)
The main objective of this study was to determine the net impact of waterway transport on the Oklahoma economy. An input-output model was the basic analytical tool. 1980 projections of impacts of the waterway since 1963 were as follows: $1.8 billion increase in state output, an additional 36,000 jobs, and an increase of $301 million personal income.

"The Feasibility of Lowering Delivery Costs through Reduced Delivery Frequency." James G. Beierlein and Robert J. Campbell (Pennsylvania State University)
The economic feasibility of reducing delivery frequency of milk to convenience stores is examined. Four reduced-delivery frequency situations are evaluated under a net present value criterion. Substantial fuel price increases are needed to justify additional capital expenditures. Substantial net savings are possible if no additional capital expenditures are required.

Rural Development Models: Input-Output and Simulation (Shirley Elliott, ECSC/STAT, USDA, Chairperson)

"An Econometric Approach to Input-Output Analysis for Rural Areas." Bill Miller and Clayton Anderson (University of Georgia)
An eight-equation econometric model is presented as an alternative to input-output models for rural areas. The conceptual basis for the model is defined and the multiplier matrix resulting from one application is discussed briefly. General acceptance of the model by users and readily available secondary data suggests that further applications would be warranted in other rural areas.

"Use of Input-Output Relationships in Conjunction with Benefit-Cost Analysis for Water Resource Development Projects." Richard T. Clark (NRED, ESCS, USDA)
The proper use of input-output for estimating regional benefits and costs is described for instances where project outputs go to final or intermediate demand. How that estimation is affected by the method used to value the primary project benefit is

discussed as are points of terminological confusion between the two methods.

"The Decomposition of Standard Input-Output Model Estimates." Edward E. Ives (Ohio State University), Herbert H. Stoevener and W. Edward Schmisseur (Oregon State University)
Procedures are presented for decomposing any sector's output according to the endogenous sectors to which it flows. Each sector's production to the endogenous sector is further decomposed according to the amounts attributable to each final demand component. The decompositions will be widely applicable and easy to compute, present, and interpret.

"Transforming Traditional Forage/Beef Systems to Improve Human Nutrition in Tropical Africa." G. M. Sullivan, K. W. Stokes, D. E. Farris, T. E. Nelson, T. C. Cartwright, and A. J. Dye (Texas A&M University)
Livestock systems based on uncontrolled communal grazing result in inefficient utilization of native forages and low livestock production. Forage/beef system simulation models are adapted to Tanzania to evaluate a case of improved technology. A hay enterprise for lactating cows, not possible with uncontrolled communal grazing, is found to increase nutritional and monetary welfare of a typical village.

"Structural Change in Agricultural Production Firms and Regional Employment." David L. Watt (NEAD, ESCS, USDA)
Projections of regional employment in 1980 under five scenarios are calculated for a seven county region in south-central Iowa. Scenarios were designed to identify the impacts of shifts in farm size, the multiplier effect of agricultural employment, structural changes resulting from the increase in farm size, the income effect of absentee ownership, and an industrial type organization of farms purchasing most agricultural inputs from outside the region. The employment impacts are calculated using an eight sector input-output model based on employment data.

Rural Development Incentives (Jeanne O'Leary, EDD, ESCS, USDA, Chairperson)

"Fiscal Impacts of Public Programs: A Case of 'Back-to-the-Land' Growth." Gerald Marousek (University of Idaho)
Benefit-cost analysis was used to examine fiscal impacts of eight public programs on two types of residents in an Idaho rural community. "Back-to-Land" residents paid fewer costs than conventional rural dwellers, but also received fewer benefits. Household age composition rather than life-style, may have been primarily responsible for the differences.

"Migration Impacts on Investment in Public Schools: An Econometric Study of Wisconsin School Districts." George W. Morse (Ohio State University)
If nonparents support education as an investment in social benefits, expenditures will decline as outmigration increases. This hypothesis was tested using Wisconsin school district data, gross migration rates, and single and simultaneous equation models. The results support the investment hypothesis and the need for explicit spillover compensation formulas.

"Differential Impacts of Use Value Taxation on Local Property Tax Bases Over Time." Hiroshi Yamauchi (University of Hawaii)
Relative distributional impacts are measured by comparing effective tax rates with versus without (simulated) the use value program in Hawaii. Economic growth and capitalization of taxes both tend to lessen long-term transfer effects, more so in SMSA than in rural counties, even if the growth potentials of foregone taxes are taken into account.

"Cost Incentives for Joint Municipal and Industrial Wastewater Treatment." Daniel Rossi (Rutgers University), C. Edwin Young (ESCS, USDA), and Donald J. Epp (Pennsylvania State University)
Costs for separate and joint municipal and industrial wastewater treatment are simulated for rural communities. Joint treatment can reduce average treatment costs, with the distribution of the cost savings dependent upon the participants' relative bargaining strength. Reductions in industrial wastewater discharges into existing facilities can result in higher community costs.

"The Self-Employment Bias in the Unemployment Rate: Differential Metropolitan, Nonmetropolitan Effects." Sigurd R. Nilsen (EDD, ESCS, USDA)
The unemployment rate, generally viewed as a consistent indicator of labor market performance, contains inherent biases. One of these, the level of self-employment, systematically reduces the unemployment rate in nonmetropolitan vis-a-vis metropolitan areas. The resultant effect is a 20% reduction in nonmetropolitan rates as compared to a 10% reduction in metropolitan rates.

Water: Supply, Utilization, and Disposal (Louise Arthur, University of Arizona, Chairperson)

"Impact of Increasing Natural Gas Prices on Groundwater Use in the Texas High Plains." Kenneth B. Young and Jerry M. Coomer (Texas Tech University)
Irrigation costs, groundwater depletion, cropping patterns, and annual net farm income were projected over the period 1976–2026 for a thirty-two-county area of the Texas High Plains. Alternative price scenarios for commodities and natural gas

were assumed. Irrigation projections were responsive to changes in natural gas prices and irrigation terminated before all groundwater was depleted in the study area.

"Opportunities for Integrating Water Conservation and Supply Control Objectives in Agricultural Policy." James A. Larson and Raymond J. Supalla (University of Nebraska)
Policy options directed at controlling the water input in agriculture were examined as methods of simultaneously solving water scarcity and farm price problems. A model farm linear programming approach was used to analyze the options for a specific geographical area. When compared to a set-aside program, the water control option appears to be attractive in terms of water conservation, production control, and government cost.

"Issues and Problems in Agricultural Water Demand Estimation from Secondary Data Sources." Gary D. Lynne (University of Florida)
Estimates of irrigation water demand value are becoming more important as water is more scarce, even in the eastern United States. Secondary data sources appear inadequate to the task. A modified Ruttan approach was used for a Florida case. At best, the estimated values are biased upward due to data problems.

"Impact of Seasonal Water Quality Standards on Municipal Wastewater Treatment Costs." C. Edwin Young (ESCS, USDA), Donald J. Epp, and Terry Brownschidle (Pennsylvania State University)
Mathematical programming is used to evaluate municipal wastewater treatment costs when discharge requirements are based on seasonal water quality characteristics. Conceptually, there are gains from utilizing such a system. Small cost savings result when secondary treatment only is required, but larger cost savings occur when advanced wastewater treatment is required.

"Stream Pollution Effects on Property Values." Donald J. Epp (Pennsylvania State University) and Kamel S. Al-Ani (Baghdad University)
An hedonic price model of residential property values including stream quality characteristics is tested with data from Pennsylvania sites. Water quality, as an index of either measured characteristics or the owners' perceptions, is shown to affect significantly the value of adjacent properties.

Sources of Energy (Sandra S. Batie, Virginia Polytechnic Institute and State University, Chairperson)

"The Economics of Natural Gas Policy Alternatives: A Case Study." T. H. Stevens (University of Massachusetts)
A case study of the net benefits of natural gas supply policy options is presented. The results indicate that imports of LNG may be preferred to coal gasification and that natural gas price deregulation yields positive net benefits.

"Impacts of Selected Price Policies on the Discovery and Extraction of Crude Oil." Angelos Pagoulatos, David L. Debertin (University of Kentucky), and Emilio Pagoulatos (University of Missouri)
This paper develops an econometric model of petroleum discovery and extraction. Impacts of three selected price policies for petroleum are analyzed with the model. Higher oil prices do encourage additional domestic oil exploration and extraction.

"Western Coal: Energy Versus Agriculture." Wallace McMartin (NRED, ESCS, USDA)
Development of western coal by strip mining uses land and water now being used for agriculture. The amount of land used for mining is estimated and the value of its production calculated. Estimates of benefits from mined land reclamation are derived from the value of agricultural production and compared with reclamation costs.

"Drying Grain with Solar Energy—Does It Show Promise?" Walter G. Heid, Jr. (CED, ESCS, USDA)
According to the results of recent economic feasibility research, solar energy looks quite promising for drying grains and other farm needs. This paper reports on the costs of solar grain drying and addresses many of the issues related to fitting this new technology into a farm management system.

"Agriculture As a Source of Fluid Energy: Gasahol et al." Wallace E. Tyner (Purdue University)
Can agriculture produce fluid energy economically? This paper examines the cost of producing alcohol from grain and agricultural by-products and compares that cost with current market values for industrial alcohol and gasoline. The paper concludes that agricultural sources could compete in the industrial alcohol market but that gasahol currently is not economical.

Award-Winning Theses

King, Robert Philip. "An Analysis of Rural Consumption Patterns in Sierra Leone and Their Employment and Growth Effects." M.S. thesis, Michigan State University, 1977.

This study focuses on growth and employment effects associated with rural consumption patterns in Sierra Leone. In particular, the factor intensities of rural consumer demand at different income levels are examined in light of the hypothesis that the labor requirement per unit of consumption expenditure decreases as household income increases, while capital and foreign exchange requirements increase. The strength of consumption-based intersectoral and rural-urban market linkages is also investigated.

Data for the study were obtained from a survey conducted continuously over a twelve-month period. In addition to information on cash expenditures, data on household production and sales used to determine subsistence consumption were collected for the sample of 203 households. To permit analysis of the factor requirements and intersectoral linkages associated with consumer demand, commodity groupings were kept highly disaggregated during data collection, and the origin of purchased goods was recorded.

Average and marginal propensities to consume and total expenditure elasticities for a disaggregated set of commodities and for commodities grouped by origin are estimated for six income classes. Marginal factor requirements associated with the consumption pattern of each income class are then presented.

The results of the analysis support the hypothesis that capital and foreign exchange requirements per unit of consumption expenditure increase and labor requirements decrease as incomes rise. Variation in factor intensities is not pronounced, however. The strength of intersectoral and interregional market linkages is found to be relatively invariant with respect to changes in income. Rural-urban linkages are weak, indicating that the impact of rural development programs on urban sectors may be limited.

Sarris, Alexander H. "The Economics of International Grain Reserve Systems." Ph.D. thesis, Massachusetts Institute of Technology, 1976.

The thesis develops a general theoretical and empirical framework to analyze the economics of international grain reserves. After an initial review of past and current price behavior and institutional changes in grain markets, a general equilibrium theory of price stabilization via stockpiling under conditions of fluctuating production and demand is developed and used to explore the welfare effects of stabilization in an economy closed to foreign trade. The results indicate that there is a net overall welfare benefit from stabilization but that the allocation of benefits and losses between consumers and producers depends on the parameters of the demand and supply functions, and the source of fluctuations. An analytical argument is made that the private markets will not act in an optimal stabilizing fashion.

Extension of the closed economy results to the case of international trade reveals that the distribution of benefits from stabilization among countries and between groups within countries depends on the source of trade fluctuations, nonlinearities in the excess demand functions, farmer supply response, and the nature of trade restrictions. In light of the theoretical discussion, a simulation model of the world wheat economy specifically designed for reserve stock analysis is specified and estimated statistically for nineteen countries or regions. The econometric estimates are compared to those of other studies and the complete model is calibrated for the base year 1974.

Monte Carlo simulations over a twenty-year period are used to examine the likely distribution of benefits from the institution of a world wheat reserve, and to conduct sensitivity analyses with respect to key parameters. The results indicate that a relatively small reserve (10–15 million metric tons) operating with a wide price band will provide a substantial reduction in expected world price fluctuations and offer a reasonable degree of food security for developing countries.

Walker, David John. "An Economic Analysis of Alternative Environmental and Resource Policies for Controlling Soil Loss and Sedimentation from Agriculture." Ph.D. thesis, Iowa State University, 1977.

This study considered the dual problems associated with water erosion of soil from agricultural lands, diminished productivity of the land, and the sediment pollution of surface waters. Government and private research have suggested that unless the present rate of soil loss is reduced, the nation's future food production potential may be threatened and the water quality objectives specified in PL 92–500 compromised. Effects of environmental and resource policies for controlling soil loss and sedimentation in a selected Iowa river basin were simulated with a linear programming model under three price scenarios.

The model incorporated 109 crop production activities consisting of four crops, five crop rotations, three tillage systems, and three conservation treatments on thirteen land classes. The policies evaluated included ban on fall moldboard plowing, annual soil loss limit of 5 tons per acre, ban against straight-row cultivation on slopes, soil loss tax, subsidy for contouring, subsidy for minimum tillage, and various combinations of these policies. Based on the assumption of profit maximization by farm operators, the simulation results indicated effects of alternative policies on net farm income, crop production levels, average soil loss, agricultural contribution to stream sediment load, choice of technology, and land use. Analysis with the model revealed the equivalence of various policies in reducing soil loss and sedimentation and also demonstrated the redundancy of some policy combinations.

Ban on fall plowing, soil loss tax of $.10 to $.20 per ton depending on the price scenario, and subsidy for minimum tillage were each capable of reducing soil loss and agricultural sediment pollution by 50% with income penalties varying from 2% to 3%. Subsidy for contouring was not capable of reducing soil loss significantly because contouring is not effective on the steeper, highly erosive slopes. Further reductions in soil loss and sediment pollution by as much as 90% were realized with more restrictive policies. Dual ban on fall plowing and straight-row cultivation on slopes, annual soil loss limit of 5 tons per acre, and soil loss tax of $.50 to $1.50 per ton achieved this standard and resulted in an income penalty of less than 14%.

Ward, Frank Alan. "The Welfare Effects of a Market Allocation of an Exhaustible Resource." Ph.D. thesis, Colorado State University, Fort Collins, 1977.

In recent years, cost-benefit economists have developed "net benefit" measures of welfare change attributable to shifts in the allocation of flow resources. Presumably, such welfare-change measures have been developed as an attempt to minimize the wastage of resources on economically unsound projects. However, to the author's knowledge, no such welfare-change measure has been developed to rank alternative allocations of an exhaustible resource. This dissertation attempts to devise such a measure. The measure is developed in three steps.

The first step (chap. 2) is an explanation of how a free market allocates the exhaustible resource over time. Knowledge of the allocation explored in this step is important, because, once determined, the market outcome can be compared to some appropriately-defined efficiency norm.

The second step (chap. 3) develops an efficiency norm as a basis for determining whether the market depletes the exhaustible resource too quickly, too slowly, or at the right rate.

The third step (chap. 4) is the development of a welfare change measure which quantifies how well the market's time-use of the mineral approaches that of an efficient allocation. Specifically, this measure is designed to ascertain the net change in benefits attributable to changes in either of two generalized distortions relevant to the market for an exhaustible resource.

The results of this dissertation are that, indeed, such a welfare-loss measure can be quantified. The measure can, in principle, rank alternative allocations of an exhaustible resource on the basis of the net size of two generalized distortions, the values of which would depend on the size of the policy variable under consideration.

AAEA Business

Committee Reports

Report of the President

In a few minutes, you will hear a report from the secretary-treasurer that the membership of the Association is at an all time high, and the Association operated well in the black in 1977. In addition, this 1978 Annual Meeting breaks the record for attendance. I, and other members of the Executive Board, are pleased with these achievements. This favorable situation is the result of the work of many people in past years, as well as the many people who served this year on committees of the Association.

The work of the Association is largely achieved through committees. Approximately 250 persons serve the Association on committees. This is approximately 8% of U.S. and Canadian individual members. I wish to express my thanks to these committee members for their excellent efforts in behalf of the Association.

A prime objective of recent presidents was to assure that participation in committees is shared widely among the Association's membership. I have continued the effort to work toward this objective, and put a great deal of effort early this year into continuing the review of balance and distribution of membership on AAEA committees.

In last year's presidential address, I argued that the Association should serve both its members and society. These two objectives are not mutually exclusive. The Association serves society through provision of a set of services for its members and the agricultural economics profession, thus enabling the provision of better information for improved performance of economic institutions and the better uses of resources. While most of the Association's activities thus serve society indirectly, certain of our activities do serve society directly. I propose to review briefly the activities of the Association over the past year in this framework.

The major activity of the Association is the publication of the *Journal* and the holding of annual meetings. While controversy continues to swirl around the *Journal*, it is my judgment that it provides an outstanding service to the profession and society. One small bit of evidence—an editor of a major farm magazine reports he regularly reads or scans most of the major scientific journals in agriculture. In his view, our *Journal* is the most lively and the most useful to his work. The past and present editors of the *Journal*, and their editorial councils, deserve much of the credit.

At this time last year, we were making plans for the AAEA to raise funds for the operation of the Registry of Agricultural Economists. Developments during the year led to a Memorandum of Agreement between the Association and the Illinois State Employment Service. The Illinois State Employment Service is providing most of the funding and support for the operation of the Registry, making it unnecessary for the Association to raise these funds. The Registry has operated well during the changeover, and is making substantial progress in facilitating the labor market for the agricultural economics profession. In 1977–78 there were 10.25 placements per month, a 37% increase over the placements per month in 1976–77. Again, I would urge each member to be listed in the Registry, and employers to utilize the Registry in seeking candidates for positions. The Registry is now on a firm footing. It grew out of a grant from the U.S. Department of Labor to the Association. A report to the Department of Labor, on the development and operation of the Registry, will be presented by the end of this year. Much of the work in the development of the Registry and its improvement rests with Loys Mather, chairman of the Registry Committee in earlier years; Dave Boyne, current co-chairman of the Professional Registries and Employment Committee; and the able assistance of people on his committee, especially Steve Harsh. We owe that group a debt of gratitude.

The Board took action to implement certain recommendations of the Alternative Publications Committee, chaired by Verner Hurt. A newsletter will be published on a regular basis, six issues per year, beginning in January 1979. It will be a modest, minimum cost publication that will include the items normally in the "President's Newsletter," certain "soft," but well-read material that appears in the *Journal*, i.e., news notes, committee lists, lists of Ph.D. recipients, and so forth. The newsletter will provide a much increased timeliness in communication to the members. In addition, contributed papers from the annual meeting will be forwarded to University Microfilms, Ann Arbor, Michigan, and the American Agricultural Economics Documentation Center. Thus, this literature will become more readily available. All of these actions should improve the exchange of information among agricultural economists and lead to improved performance of agricultural economics professionals and their institutions in serving the needs of society for improved agricultural economics information.

The International Committee developed a proposal and obtained AID funding for a project entitled, "Needs and Strategies for Improving Training of Agricultural Economists for Work in International Agriculture Development." The study builds on a 1973–74 study sponsored by the AAEA and the Agricultural Development Council. Both mail and personal interview surveys will be made of U.S. trained professionals from LDC's. The results of these studies will be presented at the 1979 annual meeting, and a special workshop planned in conjunction with the 1979 meetings of the International Association of Agricultural Economists. We owe the members of the International Committee our gratitude for their efforts on this and other projects.

It is expected that volume 3 of the series of Postwar Literature Review will be in the hands of the University of Minnesota Press late this year or early next year. This will complete the series intended to improve the quality of the agricultural economics knowledge developed by the profession. Our thanks are due to the many people who have worked so long and hard on this project.

Our profession has become more concerned about the quantity and quality of data available for agricultural economics analyses. The Economic Statistics Committee was involved with jointly planning and sponsoring an Agricultural and Rural Data Workshop held in May 1977. The proceedings from the discussion of indicators of the well-being of rural people provided basic background information for the recently appointed National Commission on Employment and Unemployment Statistics. The Economic Statistics Committee has three task forces operating: the first one on the economic value of statistical information, one on the measurement of agricultural productivity, and a third on agricultural outlook. At this meeting, an Organized Symposium discussed the steps the Association might take to help improve the quality of agricultural outlook. These activities have and will make significant contributions to improving the quality of data available for decision making about agriculture and rural affairs.

The American Agricultural Economics Documentation Center, a joint effort of the Association and the Economics, Statistics, and Cooperatives Service of the USDA, continues to improve its ability to serve agricultural economics scholars, as well as scholars from other fields. A total of 1,227 citations were added to the files in the first six months of 1978. Citations on Canadian cooperatives, cooperative literature by Canadian authors, and material on cooperatives published in Canada, have also been added. Preliminary discussions of cooperation between World Economics and Rural Sociology Abstracts and the American Agricultural Economics Documentation Center are under way. While a definitive study of users of the Documentation Center has not been undertaken, there is evidence of steadily increasing use by ESCS workers. The Documentation Center improves the working of the marketplace of ideas and, thus, helps the profession serve society. If you have not, I hope you will visit the demonstration of the Documentation Center at this meeting.

The Board and its committees are exploring methods of directly communicating to society, including symposia sponsored by the Association and other methods. Among the many future opportunities for the Association is the development of activities which directly serve society.

A number of activities deal more with internal issues of the Association. A Committee on Management, Structure, Methods, and Procedures is at work. A preliminary report was received by the Board at this meeting, and a final report will be acted upon at a winter Board meeting. Under the leadership of past presidents and able chairmen of the Finance Committee, the Board has improved budget preparation and control, as well as decision making concerning the investment portfolio of the Association. A significant part of the Association's ability to operate in the black is due to these improved processes. The Resident Instruction Committee, in addition to keeping the Undergraduate Program in a strong position and developing an Invited Papers Session at this meeting, is preparing a brochure for potential undergraduate students in agricultural economics and exploring how AAEA may better serve the needs of bachelor of science graduates in agricultural economics.

I wish to report the Board has conducted an evaluation of the office of secretary-treasurer. Based on the evaluation, the Board extended an offer to John Redman to continue as secretary-treasurer for a series of three one-year terms. Our thanks are due to John and the University of Kentucky for past and future service.

I have enjoyed the opportunity to serve as president of the AAEA in 1977–78 and to contribute, in some small way, to the advancement of the Association and the profession. I have learned what a wonderously complex and vital Association we have. While I look forward to relief from some time and effort which accompanied the office, I nevertheless leave the office with feelings of optimism and excitement concerning opportunities for the Association to better serve the diverse interests of its members, the profession, and society.

Although we are a "not-for-profit" organization, I would remind you we are also a "not-for-loss" organization. Careful control of expenditures are important, but more important is continued growth in membership. We cannot improve our services to society and our members without sufficient resources.

The constitution of the Association states: "The goal of the Association is furthering the development of agricultural economics knowledge." Both society and the Association members will be served to the degree that the Association stimulates, fosters, and demands excellence. I close with the last statement of my presidential address: "Let us join in assaulting the barriers to excellence in the development of agricultural economics knowledge."

R. J. Hildreth, President

Resolutions

Being the sense of this meeting that Virginia Polytechnic Institute and State University has been the perfect host for this joint annual meeting of the

Table 1. Number of Members and Subscribers, 1977, with Comparisons

Category	1970	1971	1972	1973	1974	1975	1976	1977
Institutional members	39	34	25	20	22	25	26	36
Regular members								
U.S.	2,667	2,856	2,802	2,504	2,756	2,779	2,731	2,976
Foreign	534	486	601	487	480	503	766	809
Senior members[a]	0	0	0	0	0	0	47	98
Junior members								
U.S.	494	635	398	316	338	484	483	482
Foreign	84	53	38	161	68	66	49	41
Corresponding[b]								
U.S.	4	2	0	0	1	2	0	0
Foreign	95	100	82	184	198	207	0	0
Libraries and businesses								
U.S.	596	619	647	635	667	670	572	725
Foreign	1,031	1,111	1,196	1,168	1,242	1,227	1,164	1,245
Exchange	3	2	2	3	3	3	3	3
Total	5,547	5,898	5,791	5,478	5,775	5,966	5,841	6,415

[a] New, category established in 1976.

[b] Category combined with regular members in 1976.

American Agricultural Economics Association and the Canadian Agricultural Economic Society, be it resolved that the American Agricultural Economics Association expresses its great appreciation to President W. E. Lavery, Conference Coordinator R. Lee Chambliss, Steering Committee Chairperson Joseph D. Coffey, Conference Treasurer M. C. Conner, the chairpersons and members of the eleven local arrangements committees, the faculty members and families of the Department of Agricultural Economics and to their associates in the Continuing Education Center at this University for their hospitality and long hours of work which made this annual meeting a memorable professional experience, an opportunity for renewing old acquaintances and a time for family recreation.

Be it further resolved that a copy of this Resolution be sent to President Lavery, Professors Chambliss, Coffey and Conner, to each of the local arrangements committees and to other persons as appropriate.

Report of the Secretary-Treasurer

The AAEA membership for 1977 reached an all time high of 6,415, an increase of 574 members and subscribers (table 1). This growth has helped to keep the Association in a good financial position because of the low marginal cost of a member. Several factors contributed to this growth. First, we had a good effort on the part of John Lee and his Membership Committee. Other factors include membership discount on books; differential registration fee for the annual meetings; invitations to members only to serve on committees, to be listed in *Handbook-Directory,* and to give papers at meetings, etc. Also, I sense there is a greater awareness of the need to belong to one's own professional society to be regarded by his peers and others as a professional person.

The number of members who paid their dues on or before 1 April and therefore received a ballot to vote continues to remain fairly constant (table 2). Through a continuous effort by my office, we are able to build the membership back to indicated levels by the end of the year.

The operating statement (table 3) for 1977 showed a surplus of $48,617.00, which was very good news. Let me caution everyone in analyzing operating statements that extraordinary items often convey normal activity. Two items merit particular attention. We netted $11,700.38 from our San Diego meeting. Second, we reduced the accounts payable by $7,000.00. These two items accounted for nearly $19,000.00 of the increase. Another item of lesser importance is the literature review which actually has a loss but because of the lag in remitting the account shows a net gain of nearly $1,200.00.

On the expense side, the *Journal* printing included five (5) issues plus the *Handbook-Directory.* Office supplies and printing were up because of large number of surveys made last year. Secretarial assistance increased because of the changeover of personnel. Other expenses are rather normal.

The national registry project funded by a USDL

Table 2. Numbers of Members Paid by 1 April, Ballots Mailed and Returned, with Comparisons, 1974–78

Category	1974	1975	1976	1977	1978
U.S. members	2,401	2,746	2,878	2,721	2,756
Canadian members	178	156	175	170	157
Foreign members	248	592	443	452	440
Total ballots mailed	2,827	3,494	3,496	3,343	3,353
Total ballots returned	1,920	1,850	1,624	1,751	1,712

Table 3. 1977 AAEA Operating Statement, with Comparisons, 1973–77

Item	1973	1974	1975	1976	1977
Income ($)					
Dues and subscriptions:					
Regular members	56,513.62	53,723.13	55,545.54	87,951.61	98,894.27
Senior members	0	0	0	537.50	799.50
Junior members	1,983.84	2,607.92	4,295.14	8,294.28	7,704.73
Subscriptions	35,141.97	38,430.19	39,531.64	56,534.56	49,278.74
Corresponding	840.00	930.00	1,940.00	3,540.00	0
Institutional	2,000.00	2,200.00	2,500.00	2,600.00	3,600.00
Literature retrieval	5,230.87	5,261.76	3,283.56	0	0
Journal publications:					
Journal sales	4,444.89	5,273.75	5,714.20	5,156.00	9,405.75
Page charges and reprints	3,259.31	4,452.50	9,575.50	26,700.50	31,294.55
Advertisements	1,065.00	819.64	824.80	1,375.50	327.75
Royalties	0	0	979.80	557.77	1,325.68
Other	0	0	184.61	0	0
Postwar Literature Review sales	0	0	0	569.00	9,582.00
Investments	7,799.37	8,593.25	9,040.60	9,535.75	12,307.89
Annual meeting	344.67	4,193.34	269.80	710.27	1,369.34
Address labels	835.12	935.40	557.96	1,215.92	1,590.56
Miscellaneous	5,026.90	16,335.53[a]	278.84	223.00	427.13
San Diego	0	0	0	0	26,407.30
Total ($)	124,485.56	143,756.41	134,521.99	205,501.66	254,315.19
Expenses ($)					
Journal					
Printing	70,483.40	81,752.64	79,324.15	95,703.42[b]	88,733.15[c]
Editorial support	15,600.00	23,400.00	17,700.00	20,000.00	30,000.00
Printing reprints	1,843.76	3,152.71	2,285.23	2,892.23	6,045.11
Purchase *Journals*	1,028.80	569.64	323.90	165.00	147.00
Literature retrieval-document center	7,729.33	10,655.14	18,862.22	13,942.20	15,000.00
Postwar literature review	0	0	0	15,207.76	8,410.50
AAEA (International Conference) grant	5,000.00	0	0	5,000.00	0
Handbook-Directory	0	0	0	2,794.04	0
Awards	600.00	1,500.00	1,500.00	1,500.00	1,500.00
Student activities	842.90	1,129.89	0	0	0
General operations:					
Postage and phone	1,679.09	2,962.58	3,879.52	4,465.89	4,611.27
Office supplies and printing	3,248.41	2,385.91	4,330.22	2,811.80	6,532.83
Annual meeting	1,485.46	4,460.74	1,712.94	1,270.88	2,814.24
Committees	272.68	357.25	460.27	1,211.38	1,040.52
Bonds	298.00	149.00	149.00	149.00	115.00
Audit	0	200.00	400.00	500.00	500.00
Secretary-treasurer assistant	12,851.48	13,874.50	14,000.83	15,727.81	20,750.03
Secretary-treasurer honorarium	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00
Miscellaneous	9.76	15,435.83[a]	849.66	810.30	791.62
San Diego	0	0	0	0	14,706.92
Total ($)	126,973.07	165,985.83	149,777.94	188,151.71	205,698.19
Balance ($)	−2,487.51	−22,229.42	−15,255.95	17,349.95	48,617.00

[a] Includes $15,000 Rockefeller Grant received and expended.
[b] For six issues of the *Journal*.
[c] For five issues of the *Journal* and *Handbook Directory*.

grant had a year-end deficit, totaling $15,002.57 (table 4 and 6). It was known that additional money was coming. Eventually this project will close with zero balance and the small amount of funding needed for future operations will be placed in the regular budget.

In accordance with the policy established in 1973, the income-expense statement for editorial support as provided by the editor is incorporated as a part of this report (table 5).

The balance sheet for AAEA showed again considerable improvement because of the positive balance of $48,617.00 (table 6). An item of note is that the amount of prepaid dues and subscriptions in 1977 was approximately equal to that of 1975, the year of the forthcoming *Handbook-Directory*. I have no explanation why 1977 is so much higher than 1976.

In summary, the Association is healthy once more. The immediate problems facing us are infla-

Table 4. 1977 U.S. Department of Labor Grant Operating Statement, with Comparisons, 1973–77

Item	1973	1974	1975	1976	1977
			$		
Income:					
Beginning balance	0	25,100.34	7,434.10	8,844.22	−753.05
Amount received	37,500.00	32,000.00	49,500.00	22,000.00	15,000.00
Expenses	12,399.66	49,666.24	48,089.88	31,597.27	29,249.52
Ending balance	25,100.34	7,434.10	8,844.22	−753.05	−15,002.57

Table 5. Combined Income-Expense Statement of Editorial Offices, 1977

Income ($)	
AAEA Appropriation	30,000.00
Expenses ($)	
Salaries of assistant editors, secretaries	27,436.52
Postage	2,611.43
Copying	345.00
Telephone	815.20
Supplies	754.70
Total	31,962.85
Balance ($)	−1,962.85

tion and increasing pressure to undertake more and more activities. Needless to say, I was rather busy during 1977, particularly since the San Diego meeting arrangements were handled by my office.

John C. Redman, secretary-treasurer

Report of the Audit Committee

The Audit Committee employed the accounting firm of Moore, Wilson & Smith to examine the financial records of the AAEA in 1977. Their report is as follows.

"We have examined the balance sheet of the American Agricultural Economics Association as of December 31, 1977, and the related statement of receipts and disbursements, fund balance and changes in financial position for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

"In our opinion, the financial statements referred to above present fairly the financial position of the American Agricultural Economics Association as of December 31, 1977 and the results of its financial position for the year then ended in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year."

Report of the Investment Committee

The portfolio of AAEA, which did not change during 1977, produced an income of $12,307.89. The stocks carried on the books at cost of $102,551.99 had a market value of $176,042.125 at the close of

Table 6. Combined Balance Sheet, 31 December 1977, with Comparisons

	1973	1974	1975	1976	1977
Assets ($)					
Cash-bank	81,117.43	54,195.05	54,940.54	12,321.25	47,361.82
Cash-bank, USDL	25,100.34	7,434.10	8,844.22	0	0
Cash-UK	(135.99)	291.25	1,714.21	3,510.28	4,982.99
Cash-broker	2,123.08	1,896.63	10,937.23	1,546.92	4,205.57
Prepaid expenses	0	8,850.00	0	0	0
Investments ($)					
Certificate of deposit	0	0	0	40,000.00	40,000.00
Ready asset	0	0	0	7,546.43	15,568.23
Stocks (at cost)	102,551.99	102,551.99	102,551.99	102,551.99	102,551.99
Approximate market value	182,886.125	136,432.625	159,310.125	202,490.50	176,042.125
Total assets (at cost) ($)	210,756.85	175,219.02	178,988.19	167,476.87	214,670.60
Liabilities ($)					
USDL unspent funds	25,100.34	7,434.10	8;844.22	(753.05)	(15,002.57)
Prepaid dues	27,895.67	32,253.50	49,868.50	30,604.50	50,430.75
Accounts payable	30,116.10	30,116.10	30,116.10	30,116.10	23,116.10
Net worth	127,644.74	105,415.32	90,159.37	107,509.32	156,126.32
Total liabilities	$210,756.85	$175,219.02	$178,988.19	$167,476.87	$214,670.60

Table 1. AAEA Summary of Investments, Year Ending 31 December 1977

	Income ($)	Value ($)	
	1 Jan.–31 Dec. 1977	Cost	Market
Stocks			
On hand, 1 Jan. 1977		102,551.99	202,490.50
On hand, 31 Dec. 1977		102,551.99	176,042.125
Dividends	10,183.65		
Ready asset trust	496.80	15,568.23	
Certificate of deposit	1,627.44	40,000.00	
Total	12,307.89	158,120.22	

Table 2. Value of AAEA Stocks, 31 December 1977

				Market Value ($)		
Company	No. of Shares	Original Cost ($)	Dividends 1977 ($)	31 Dec. 1975	31 Dec. 1976	31 Dec. 1977
Amer. Cyanamid	250	9,143.43	375.00	6,218.75	6,968.75	6,687.50
Amer. Tel. & Tel.	288	11,421.11	1,180.80	14,652.00	18,288.00	17,424.00
Amer. Tel. & Tel. $4CV	300	16,934.00	1,200.00	16,537.50	19,950.00	19,012.50
Borden	228	2,162.41	346.56	6,070.50	7,752.00	6,982.50
Chase Manhattan	93	1,115.09	204.60	2,557.50	2,848.125	2,778.375
Clark Equipment	600	2,200.67	1,020.00	15,075.00	25,425.00	20,100.00
Con. Edison	232	7,467.14	556.80	7,018.00	7,337.00	6,699.00
Cont. Group	225	4,315.38	461.25	6,187.50	7,621,875	7,650.00
Exxon	306	10,325.36	918.00	13,578.75	16,409.25	14,726.25
Goodyear	500	16,692.50	600.00	10,875.00	11,875.00	8,625.00
Jewell	150	3,875.94	195.00	2,000.00	3,581.25	2,962.50
NICOR	7	—	13.32	156.625	208.25	220.50
Sears Roebuck	608	1,845.38	632.32	19,608.00	20,976.00	17,024.00
Standard Oil Ind.	800	7,356.68	2,080.00	34,100.00	47,700.00	39,600.00
Texaco	200	7,696.90	400.00	4,675.00	5,550.00	5,550.00
Total		102,551.99	10,183.65	159,310.125	202,490.50	176,042.125

business year, decreasing by $26,448.375 from the previous year (table 1). Our investments in stocks yielded $10,183.65 in dividends (table 2).

Obviously, the stock market has not been kind to us. Only two stocks—Continental Group and NICOR—were worth more at the end of 1977 than at the beginning. The total market value declined from about two times the cost to about one and three-fourths. Based on cost, the stock produced nearly a 10% return but when based on value at the beginning of the year the yield was 5%.

John C. Redman

Report of the Finance Committee

The primary activities of the finance committee since the San Diego meetings have been to monitor income and expense experience of the Association for 1977 and 1978, prepare materials for the 1979 budget (tables 1, 2, 3, and 4), implement management of the investment portfolio, and study the need for insurance coverage for the board members, secretary-treasurer, and Association activities.

The finance committee is pleased to note that the AAEA's final operating statement for 1977 showed the second consecutive positive balance after three annual deficits. The continued improvement of the Association's financial affairs reflects increased membership at higher dues, careful monitoring of Association expenses, higher returns on the portfolio, and profits generated from the San Diego meeting. Commendations are due the secretary-treasurer and all the committees for their efforts to work within budget guidelines.

Individual members of the finance committee have assumed major responsibilities for one or more of the Association's important enterprises and activities by monitoring expenditures and assisting in the development of the budget. Assignments were Boehlje, chairman of the investment portfolio subcommittee; Brake, literature retrieval and investment portfolio; Coffey, insurance needs of the Association; Redman, investment portfolio; and Barr, *Journal* and office of secretary-treasurer.

During the year the finance committee met once by use of a conference call and once in an all-day meeting in Columbus, Ohio, to develop budgets and make recommendations for management of the portfolio.

Implementation of the management of the As-

Table 1. AAEA Expense Statements and Budgets

	Actual Expenses ($)			Budgets ($)	
Description	1975	1976	1977	1978	1979
Journal					
Printing	79,324	95,703[a]	88,733	79,200[b]	85,000[b]
Postage	0	0	0	11,000	12,750
Storage	0	0	0	1,500	1,500
Editorial support	17,700	20,000	30,000	22,500	24,500
Printing reprints	2,285	2,892	6,045	6,700	7,100
Purchase *Journals*	324	165	147	200	200
Newsletter					
Printing, 96 pages	0	0	0	0	6,500
Postage	0	0	0	0	3,300
Editorial	0	0	0	0	1,000
Labels, start-up costs	0	0	0	0	200
ABAE-Literature retrieval	18,862	13,942	15,000	15,000	15,000
Postwar Literature Review	0	15,208	8,411	7,500	7,500
Postwar book orders	0	0	0	9,750	11,000
AAEA (International Conference) grant	0	5,000	0	0	2,500
Handbook-Directory	0	2,794	0	0	0
Awards	1,500	1,500	1,500	1,500	1,500
Employment services	0	0	0	2,000[c]	2,500[c]
San Diego meeting	0	0	14,707	0	0
General operations					
Postage and phone	3,880	4,466	4,611	8,000	7,000
Office supply and printing	4,330	2,812	6,533	4,000	4,500
Annual meeting	1,713	1,271	2,814	2,000	3,000
Committees	460	1,211	1,040	1,200	1,500
Bonds	149	149	115	150	150
Audit	400	500	500	600	600
Secretary-treasurer assistant	14,001	15,728	20,750	17,000	18,500
Equipment purchase: rental	0	0	0	11,500	2,000
Equipment service	0	0	0	800	900
Secretary-treasurer honorarium	4,000	4,000	4,000	5,000	5,000
Miscellaneous	850	810	792	3,000[d]	3,000[d]
Total expenses	149,778	188,152	205,698	210,100	228,200

[a] Includes six issues of the *Journal*.

[b] Budgets and AAEA operating statements formerly did not separate printing, postage, and storage costs.

[c] Illinois State Employment Service–AAEA agreement to finance travel of a representative to AAEA conference, print forms, and publicize an employment registry. ISES assumes the cost of operating the employment service.

[d] Hourly labor costs that will be reported in actual expenses as secretary-treasurer assistance.

sociation's portfolio has, upon Executive Board approval resulted in buying—upon advice of the finance committee, the brokerage house holding the portfolio (Merrill Lynch), and the IAA Trust Company—of equity issues in American Cyanamid, Santa Fe Industries, Borden, and CIT Financial. In addition, debt issues—Commercial Credit Corporation, CIT Financial, and Federal Land Bank—have been purchased. The purchases mean the portfolio is now composed of about 80% equity issues and 20% debt. This ratio compares to the goal of 85:15 ratio approved by the Executive Board one year ago.

Substantial improvements in the income from the portfolio are expected. This is due not only to the changes in the portfolio but also to implementation of the guidelines with respect to the maximum balances in the individual accounts held at the commercial bank where AAEA accounts are located.

The management procedures approved by the Executive Board during the San Diego meetings were amended in a minor way at the winter meetings (New York) upon advice of legal counsel. The amended version is printed below.

The finance committee has completed the preliminary study of insurance needs of the Association and the Board has authorized the finance committee to obtain bids for comprehensive liability insurance, workmen's compensation and office contents of the Association, and to recommend a course of action at the 1979 winter meeting.

Wallace Barr, Chairman

Report on Investment Portfolio Management Procedures

The management of the AAEA portfolio approved in 1977 and amended by the Board in December

Table 2. AAEA Income Statements and Budgets

Description	Actual Income ($) 1975	1976	1977	Budgets ($) 1978	1979[a]
Dues and subscriptions					
Regular members	55,546	87,952	98,894	92,500	92,500
Senior members	0	538	800	1,125	1,250
Junior members	4,295	8,294	7,705	6,250	6,250
Subscriptions	39,532	56,535	49,279	62,300	63,087
Corresponding	1,940	3,540	0	0	0
Institutional	2,500	2,600	3,600	3,500	3,500
Literature retrieval	3,284	0	0	0	0
Journal and publications					
Page charges collected	9,576	26,700	31,294	30,000	30,000
Sale of reprints	0	0	0	3,500	3,500
Journal sales	5,714	5,156	9,406	5,000	5,000
Advertising	825	1,375	328	1,500	1,000
Royalties	980	558	1,326	600	1,000
Other	185	0	0	0	0
Newsletter advertising	0	0	0	0	1,000
Postwar Literature Review	0	569	9,582	9,000	10,000
Investments	9,041	9,536	13,308	14,500	17,500
Meetings (ASSA; AAEA)	270	710	1,369	3,000	3,000
San Diego Meeting	0	0	26,407	0	0
Address labels	558	1,216	1,590	1,000	1,500
Miscellaneous	279	223	427	300	300
Total income	134,525	205,502	254,315	234,075	240,387
Total expenses	149,778	188,152	205,698	210,100	228,200
Balance	−15,253	17,350	48,617	23,975	12,187

[a] Dues and subscriptions and estimates in 1978 based on: regular members—3,700 at $25 = $92,500; senior members—100 at $12.50 = $1,250; junior members—500 at $12.50 = $6,250; subscriptions—1,225 at $31.50 = $38,587 and 700 at $35.00 = $24,500; and institutional—35 at $100 = $3,500, for a total of $166,587 from 6,260 members and subscriptions.

Table 3. Enterprise Budget for Publication of the *Journal*

Description	Approved 1976 ($)	Approved 1977 ($)	Approved 1978 ($)	Approved 1979 ($)
Expenses				
Printing,[a] 1,100 pages	77,500	80,000	79,200	85,000[b]
Postage	2,000	5,000	11,000	23,750[c]
Storage, labor, other	0	0	1,500	1,500
Editorial support	20,000	20,000	22,500	24,500[d]
Editorial support, new editor	0	10,000	0	0
Printing reprints	2,500	3,000	6,700	7,100
Purchase *Journals*	0	0	200	200
Total expense	102,000	118,000	121,000	131,050
Income				
Page charge ($40/page)	22,000	22,500	30,000	30,000[e]
Sale of reprints	500	500	3,500	3,500
Journal sales	0	0	5,000	5,000[f]
Advertising	1,000	1,000	1,500	1,000
Total income	23,500	27,000	40,000	39,500
Net enterprise cost	78,500	91,000	81,000	91,550

Note: An important part of the expenses associated with the office of the secretary-treasurer is directed to support of *Journal* activities.

[a] The three-year printing contract starting 1 January 1977 with Heffernan Press was based on an issue of 1,100 pages at $69 per page. The contract permits an increase in printing charges at a maximum of 6% in the third year (1979). Paper and mailing costs increases can be passed on.

[b] The 1979 budget reflects the 6% contractual cost increase and higher paper charges for a total of 11%. The budget is based on a 1,050 page issue with initiation of the newsletter.

[c] Postage rate increase of 30% over 1977 costs.

[d] Mandated salary increases for secretarial staff plus an increase for postage.

[e] Page charges at $40 per page on 750 pages.

[f] Reflects the recent AAEA operating statement of sales on *Journals*.

Table 4. Enterprise Budget for AAEA Newsletter

Description	Proposed 1979 Budget
(7,000 copies)	
Expenses	
Printing, 96 pages	6,500
Postage	3,300
Editorial	1,000
Labels, start-up costs	200
Total expense	11,000
Savings	
Journal: 50 pages @ $60 per page	3,000
Less mail and production cost of secretary-treasurer	900
Earnings	1,000
Total	4,900
Net enterprise cost	6,100

1977 is a combination of "internal" and "external" management. In general, the procedure involves the specification of goals concerning the desired performance of the portfolio (current income, growth in dividends, risk), periodic reviews of the portfolio by the brokerage house or investment service holding the account, and implementation of any recommendations concerning changes in the portfolio by a committee of AAEA members. Such a procedure provides flexibility in utilizing the services of several advisory services if conditions warrant, offers lower cash costs than the professional service option, and enables the Association to move from growth-oriented equity issues to income-oriented debt issues as market rates or needs of the Association change.

The steps to be followed in implementing this procedure follow: (*a*) Specify and periodically review the goals concerning portfolio performance. These goals will include the risk, current income, and growth dimensions of the portfolio. For 1978 conditions, the following objectives on performance are recommended: choose a low-risk portfolio of securities, achieve a 7.0% annual rate of return, and achieve a 5.0% rate of growth in dividend payout. Initially, the portfolio will be comprised approximately of 85% equity issues and 15% debt issues, although these proportions may change as national economic conditions change.

(*b*) The portfolio will be managed according to the "efficient market hypothesis." (pp. 1122–23 in December 1977 *AJAE*) The following procedures will be used. (*i*) A minimum of two reviews of the AAEA investment portfolio will be conducted each year as part of the responsibility of the Finance Committee. These reviews will be completed before each regular meeting of the AAEA Executive Board.

(*ii*) A portfolio subcommittee of the Finance Committee, consisting of two members of that committee plus the secretary-treasurer will undertake an initial review and analysis. As part of this process, at least one other set of professional opinions concerning the portfolio will be obtained besides that of the brokerage firm currently holding the AAEA portfolio. The subcommittee will be encouraged to use the expertise of selected AAEA members and/or facilities of their employers as they deem necessary and appropriate.

(*iii*) The portfolio committee will present a summary of their analysis and recommendations to all members of the Finance Committee for review and discussion. The Finance Committee, as a whole, will recommend specific actions on portfolio changes, especially risk management procedures, to the AAEA Executive Board. Both the recommendations and explanatory materials will be forwarded to the Board.

(*iv*) Changes in the portfolio will be authorized with a two-thirds vote of the AAEA Executive Board. If such approval is not received, no changes in the portfolio will occur. Executive Board review and action may be obtained without a formal meeting where appropriate. In such cases a conference call and written confirmation of the action taken by the Executive Board shall be utilized.

(*v*) Discussion of procedures followed by the Finance Committee, mechanisms used to review the portfolio, and specific target objectives for managing the portfolio will be appropriate items for the AAEA Executive Board.

Wallace Barr, chairman

Report of Tellers Committee

Ballots received from the secretary-treasurer of the AAEA were counted in accordance with the bylaws of the association to preserve the secrecy of the ballots. Candidates receiving the largest number of votes were: Richard A. King, for president-elect, John A. Hopkin and Thomas G. Brown for directors.

Lynn W. Robbins
Joe T. Davis

Report of the Editor

Our goals as editor are twofold. First, we want to maintain a high quality of economic analysis in applied and theoretical papers. This applies, of course, to standard and more quantitative manuscripts. Second, we want to encourage authorship of papers of general interest, the type that many members like to read but few want to write. Under the capable direction of my associate, Stan Johnson, the first goal is being largely achieved. Progress toward the second has been slow. We again reaffirm our statement in the February issue (p. 151) as to our openness to a broad range of papers. We have published two invited papers and have solicited a few more that are being prepared. We would be pleased to receive suggestions of topics and potential authors for invited papers.

Submissions of 269 new manuscripts were less than the 311 of 1976–77 but nearly the same as the 263 of the previous year. We accepted 38 articles and 43 notes making an acceptance rate of 30.1%. In addition, we handled 75 manuscripts originally submitted to Bill Tomek. We expect to publish 85 Proceedings papers.

Considerable effort has gone into planning and budgeting for a possible Newsletter. If this venture is approved, members, Board, and Editor will need to learn together how to make optimal use of this new medium of communication for the Association.

The new copyright law has generated numerous requests of teachers and libraries to photocopy *Journal* articles for classroom use. We are pleased to provide such permission at no cost.

We are grateful to the reviewers (listed below) whose efforts are indispensable. Herb Stoevener, as Book Review Editor, has run the West Coast branch of our operation efficiently and punctually. We want to thank Marti Luzader, assistant editor, and Donna Taylor, secretary and recordkeeper, for their technical expertise and their sustained good humor even in moments of crisis. We have received excellent cooperation from Heffernan Press. Finally, we express appreciation for the efforts and support of the editorial council whose names appear on the inside front cover.

V. James Rhodes, editor

Report of the Awards Committee

The Awards Committee this year considered the following specific issues.

The chairman of the Awards Committee suggested that AAEA give a certificate to each AAEA member who wins the Browning Award. The President of AAEA solicited advice on the proposal from members of the AAEA Executive. Because all replies were in support of the suggestion, a certificate was prepared for presentation at the 1978 annual meeting to the winner of the 1977 Browning Award.

J. W. Pendleton, president of the American Society of Agronomy, inquired about the possibility of ASA and AAEA jointly sponsoring an annual award. The AAEA Award Committee was asked to advise on the matter. No one expressed strong support for the idea. Instead, they indicated they could be "comfortable" either with or without such an award. If awards in such areas are desirable, AAEA could make them now even without the joint support of the professional societies.

The Award Committee of AAEA studied the Eckert Report on cooperation between the American Society of Agronomy and the American Agricultural Economics Association during the year and reports as follows. Everyone applauds the effort to get some good interdisciplinary work going. It would be valuable to the nation and to international development. However, the linkage of agricultural economics should be not only with agronomists but with animal scientists, agricultural engineers, veterinarians, horticulturists, environmentalists, and so forth.

AAEA could foster interaction, too, by the editor commissioning a paper on an interdisciplinary topic. Eckert suggested that the international crop research institutes are examples of interdisciplinary research. Perhaps one of their members could write a paper.

Vernon Eidman, the immediate past chairman of the Publication of Enduring Quality committee, raised questions on obtaining high-quality nominations, the problem of comparing a book with a monograph, and the method of ranking entries by members of the subcommittee and determining a winner. Under its current chairman, A. H. Harrington, these and other concerns relating to this award were examined by members of the subcommittee.

A more detailed report has been supplied to members of AAEA Executive which makes the following recommendations. (*a*) Beginning with the 1978 Proceedings issue, the past and current winners of the Publication of Enduring Quality Award be featured. This would give the award visibility and increase interest in both the nominating process and the criteria.

(*b*) The number of possible awards be increased from one to two a year, one being for the moving fifteen-year period now used (twenty-five years to ten years prior to the year of the award) and the other for selection in some years of a publication dated more than twenty-five years earlier.

(*c*) That the description of the award in the *Journal* have the following statement added: "Nominations of one year, not rejected on the grounds of not being of enduring quality, will be cumulated into a master list and considered in subsequent years along with any new entries."

(*d*) The description of the award in the *Journal* should state succinctly that the award is to recognize a publication for the enduring quality of its contribution to the profession. This would make it clear that the competition is among publications rather than people.

There are two awards for graduate students—one at the master's level and one at the doctoral level. Questions concerning the doctoral award raised by M. Gordon Wolman, chairman of the Department of Geography and Environmental Engineering at Johns Hopkins University, and by Vernon Ruttan, University of Minnesota, precipitated a review of eligibility for the award at the master's level as well as the one at the doctoral level.

A fuller report has been supplied to Executive members of AAEA, but only what seemed to emerge as the fundamental issue (intent) and the recommendation to AAEA appear here. The real

Table 1. Reviewers, 1978–79

Philip C. Abbott
Martin J. Abel
Robert W. Acton
David J. Allee
Glenn C. W. Ames
Jock R. Anderson
Ahmed A. Araji
Paul Armington
Hossein Askari
Emil D. Attanasi
Emerson M. Babb
Chester B. Baker
Malcolm D. Bale
B. Bruce Bare
John L. Baritelle
Paul W. Barkley
Raleigh Barlowe
Wallace Barr
Claudio Barriga
Peter J. Barry
William Baumol
Calvin Beale
Manning H. Becker
Jere Behrman
Lloyd D. Bender
Gary L. Benjamin
Denis Bergman
Lee W. Bettis
Roger P. Bey
Arlo W. Biere
Hans P. Binswanger
Larry L. Bitney
Gordon E. Bivens
Martin J. Blake
Leo V. Blakley
Melvin G. Blase
William T. Boehm
James T. Bonnen
Kenneth Boulding
Nicholaas W. Bouwes
Michael Bowes
Garnett L. Bradford
Michael G. Bradley
John R. Brake
George E. Brandow
Russell Brannon
Maury E. Bredahl
Harold F. Breimyer
Lars G. Brink
Ray F. Brokken
Martin Bronfenbrenner
David W. Brown
William G. Brown
O. H. Brownlee
J. Bruce Bullock
Oscar R. Burt
Walter R. Butcher
Boyd M. Buxton
Derek Byerlee
Keith O. Campbell
Wilfred V. Candler
Patrick Cantlon
William Carson
Harold O. Carter
Anthony H. Chisholm
Lee A. Christensen
Robert L. Christensen
Marion Clawson
Willard W. Cochrane
Norman R. Collins
Dale K. Colyer
John M. Connor
James B. Cook
Michael L. Cook
Melvin L. Cotner
Arthur J. Coutu
J. S. Cramer
Terry L. Crawford
William A. Cromarty
Richard T. Crowder
David Culver
Ronald G. Cummings
J. Martin Currie
Stan G. Daberkow
Dana G. Dalrymple
Raymond Daniel
Elizabeth L. David
Richard H. Day
Alain F. deJanvry
Carleton C. Dennis
Donn A. Derr
Harold Dickherber
John L. Dillon
Gerald A. Doeksen
Otto C. Doering III
John P. Doll
Gordon Donald
Peter Dorner
Norbert A. Dorow
J. Kamal Dow
Jerry B. Eckert
Clark Edwards
Alvin C. Egbert
Vernon R. Eidman
Ludwig M. Eisgruber
Robert D. Emerson
David E. Ervin
Don E. Ethridge
Melvin D. Ethridge
Robert Evenson
Paul L. Farris
Irwin Feller
Irving F. Fellows
Richard Fenwick
Robert M. Finley
Bruce J. Florea
Olan D. Forker
Karl A. Fox
Jerry Foytik
John W. Freebairn
A. M. Freeman III
Ben C. French
R. J. Freund
Thomas L. Frey
Conrad F. Fritsch
Earl I. Fuller
Stephen W. Fuller
Wayne A. Fuller
Erik G. Furubotn
Bruce L. Gardner
B. Delworth Gardner
Peter V. Garrod
Loren V. Geistfeld
Ray A. Goldberg
Roger W. Gray
Richard Green
Russell L. Gum
Thomas F. Hady
Milton C. Hallberg
Albert N. Halter
Jerome W. Hammond
Timothy M. Hammonds
Emil B. Haney, Jr.
David E. Hansen
J. Brian Hardaker
Ian W. Hardie
Duane G. Harris
Stephen B. Harsh
Zuhair A. Hassan
James B. Hassler
Dale E. Hathaway
Robert Haveman
Joseph Havlicek
Peter Hazell
J. C. Headley
Earl O. Heady
Dale M. Heien
Richard G. Heifner
Peter G. Helmberger
John W. Helmuth
Dennis Henderson
William L. Henson
Robert W. Herdt
William M. Herr
R. Carter Hill
Jimmye S. Hillman
Geoffrey A. Hiscocks
James C. Hite
Fred Hoff
David W. Holland
Dale M. Hoover
Joseph C. Horvath
James P. Houck
Richard E. Howitt
Wen-Yuan Huang
Darrell L. Hueth
Wallace E. Huffman
Harlan G. Hughes
Verner G. Hurt
Loren A. Ihnen
John E. Ikerd
Helen Ingram
P. C. Ip
George D. Irwin
Geoffrey H. Jackson
James J. Jacobs
Harald Jensen
Edward V. Jesse
Glenn L. Johnson
Marc A. Johnson
Paul R. Johnson
Bruce F. Johnston
Ronald Jones
Max F. Jordan
Timothy D. Josling
Richard E. Just
John E. Kadlec
James B. Kau
Ronald D. Kay
Maurice M. Kelso
David Kendrick
James Kendrick
Anwar Khan
David A. King
Gordon A. King
Richard A. King
Robert W. Klepper
Darrell D. Kletke
James S. Kliebenstein
Jack L. Knetsch
Ronald D. Knutson
Jose C. Kohout
William E. Kost
Marvin W. Kottke
Kenneth R. Krause
Wesley R. Kriebel
John P. Kuehn
George W. Ladd
Larry N. Langemeier
Sharon LeDuc
Warren F. Lee
Raymond M. Leuthold
William A. Lin
Robert K. Lindner
Clifton B. Luttrell
T. Gordon MacAulay
J. Patrick Madden
Wilbur R. Maki
John W. Malone
Bruce W. Marion
Katherine Marshall
J. Rod Martin
Philip L. Martin
William E. Martin
Robert Masson
Peter Matlon
J. L. Matthews
Stephen F. Matthews
Alexander F. McCalla
Bruce A. McCarl
James W. McFarland
Stephen E. McGaughey
Andrew McGregor
James W. McKinsey, Jr.
Robert B. McKusick
Karl D. Meilke
Carmen Menezes
William C. Merrill
William Meyers
Stephen Miller
Thomas A. Miller
Robert A. Milligan
John A. Miranowski
Ezra J. Mishan
James C. Moore
Larry C. Morgan
Bernard J. Morzuch
Collette H. Moser
Timothy D. Mount
Willard F. Mueller
Wesley Musser
Lester H. Myers
Maxwell S. Myers
Glenn L. Nelson
Paul E. Nelson
Kenneth J. Nichol
James F. Nix
John A. Nordin
Roger Norton
Andrew M. Novakovic
Kolonji Ntalaja
Carl W. O'Connor

Table 1. Continued

Clayton Ogg
Duane A. Olsen
Donald D. Osburn
Frank H. Osterhoudt
Robert C. Otte
Don Paarlberg
Daniel I. Padberg
A. Parikh
Quirino Paris
David W. Parvin, Jr.
Ernest C. Pasour, Jr.
George F. Patrick
Allen B. Paul
John B. Penson
Willis J. Peterson
Todd E. Petzel
Leo Polopolus
Rulon D. Pope
Barry M. Popkin
Mark J. Powers
Anthony A. Prato
Lee Preston
Michael Proctor
Ronald Raikes
Alan J. Randall
Norman Rask
Philip M. Raup
Gordon C. Rausser
Daryll E. Ray
A. J. Rayner
Donald Regier
Joseph Reid, Jr.
Donn Reimund
Robert D. Reinsel
Franklin J. Reiss
Shlomo Reutlinger
Joseph J. Richter
Kenneth L. Robinson
Vernon L. Robinson
Lindon J. Robison
Keith D. Rogers
James A. Roumasset
E. P. Roy
Richard Rudel
William Ruesink
Vernon W. Ruttan
Daniel H. Saks
Larry E. Salathe
Abdullah A. Saleh
Charles A. Sargent
Shyamalendu Sarkar
Pasquale L. Scandizzo
Bruce A. Scherr
A. Allan Schmid
Andrew Schmitz
Kenneth Schneeberger
Richard A. Schoney
Ronald A. Schrimper
G. Edward Schuh
T. Paul Schultz
Wayne A. Schutjer
Grant M. Scobie
John T. Scott
Loren C. Scott
David Seckler
Wesley D. Seitz
Gerald L. Setter
Benjamin H. Sexauer
James D. Shaffer
Ron E. Shaffer
Jerry A. Sharples
Dale L. Shaw
J. Scott Shonkwiler
J. A. Sinden
Rudie W. Slaughter
Blair J. Smith
Stephen C. Smith
Stephen M. Smith
V. Kerry Smith
Vernon L. Smith
Edward W. Sparling
Byron G. Spencer
Thomas L. Sporleder
Harry A. Steele
Joe B. Stevens
Thomas F. Stinson
Everett Stoneberg
R. G. Stuby
N. H. Sturgess
Takashi Takayama
Hovav Talpaz
Bernard W. Taylor
C. Robert Taylor
Lloyd D. Teigen
Lester G. Telser
Robert L. Thompson
Erik Thorbecke
C. Peter Timmer
John F. Timmons
George S. Tolley
Luther G. Tweeten
Fred H. Tyner
Edward W. Tyrchniewicz
John Vondruska
James C. Wade
William W. Wade
Arley D. Waldo
Francis E. Walker
Alan S. Walter
Jerry G. West
Morris Whitaker
Fred C. White
Cleve Willis
Myron E. Wirth
Jerome Wolgin
Abner Womack
Shin-Yen Wu

issue is the intent of the awards. Is it to recognize outstanding graduate student research on agricultural economic topics or to recognize outstanding research by graduate students in agricultural economics? Since the awards are not called "Outstanding M.Sc. or Ph.D. thesis awards" but "Outstanding M.S. or Ph.D. Program awards," it appears that the Association's intent was to recognize outstanding research by graduate students in agricultural economics.

The question of which of the two approaches should be the intent of the Association in the future is not clear-cut from the responses received. To help clarify the situation, therefore, the following is recommended. In the case of both the graduate student awards, a student, to be eligible, must be

Table 1. AAEA Awards, 1977

		All Entries			Winners Only		
Award Title	No. of Awards Actually Made	No. of Entries and No. of Senior Authors	Other Authors	Total No. of Authors	Senior Authors	Other Authors	Total No. of Authors
Extension							
Less than 10 years	1	3	0	3	1	0	1
More than 10 years	1	10	1	11	1	0	1
Distinguished Policy Contribution	0	0	0	0	0	0	0
Teaching							
Less than 10 years	1	9	0		1	0	1
More than 10 years	1	7	0	7	1	0	1
M.S. Program Awards	3	26	0	26	3	0	3
Ph.D. Program Awards	3	23	0	23	3	0	3
Quality of Research Discovery	2	31	36	67	2	3	5
Quality of Communications	2	18	27	45	2	16	18
Publication of Enduring Quality	1	7	2	9	1	0	1
Outstanding *Journal* Article	1	1	2	3	1	2	3
Total	16	135	68	203	16	21	37

Table 2. AAEA Awards, 1978

		All Entries			Winners Only		
Award Title	No. of Awards Actually Made	No. of Entries and No. of Senior Authors	Other Authors	Total No. of Authors	Senior Authors	Other Authors	Total No. of Authors
Extension							
Less than 10 years	1	5	0	5	1	0	1
More than 10 years	1	5	0	5	1	0	1
Distinguished Policy Contribution	1	5	50	55	1	19	20
Teaching							
Less than 10 years	1	7	0	7	1	0	1
More than 10 years	1	5	0	5	1	0	1
M.S. Program Awards	1	30	0	30	1	0	1
Ph.D. Program Awards	3	32	0	32	3	0	3
Quality of Research Discovery	2	28	35	63	2	2	4
Quality of Communications	2	39	57	96	2	19	21
Publication of Enduring Quality	1	7	2	9	1	0	1
Outstanding *Journal* Article	1	1	1	2	1	1	2
Total	15	164	145	309	15	41	56

pursuing the degree in agricultural economics or have a major or minor in agricultural economics or be pursuing a degree in economics with the thesis on an agricultural economics' topic.

The general chairman of AAEA Awards Committee assumed responsibility for obtaining information on Canadian Agricultural Economics Society's awards comparable to that reported on AAEA awards in the Award Brochure, and for incorporating those awards into a single publication.

While one awards subcommittee had some difficulty with some members either not performing at all or not until well beyond the deadlines, operations ran smoothly for the most part.

The subcommittee on Outstanding Master's Program recommended only one winner this year instead of the usual three. There were thirty eligible nominations from twenty-three United States and three Canadian institutions, but they were judged to be generally of a lower quality than in previous years and one entry stood well above all others. Furthermore, the next group of six were not only well below but the differences in ratings assigned to them were not statistically significant.

Because the recommendation of only one award sets a precedent, this subcommittee's chairman, Larry Martin, polled the committee to determine whether they supported this recommendation. With the exclusion of one member unable to judge any entries because of illness and another who judged only the first round before leaving for Africa, only ten members in addition to the chairman remained. The chairman talked to seven of the ten members and every one of them supported the recommendation to give only one award in 1978.

Tabular information provided for 1977 and 1978 shows the number of entries (senior authors) and other information for each competition. These data show the extent of multiple authorship and raise the question as to whether submissions with multiple authors have an advantage in being selected winners (tables 1 and 2).

The winners of AAEA awards for 1978 are listed below.

Distinguished Extension Program

Less than ten years. **David C. Petritz**, professor, Purdue University.

Ten or more years. **Thomas Everett Nichols, Jr.**, professor, North Carolina State University.

Distinguished Policy Contribution

J. B. Penn, program leader, Commodity Economics Division, ESCS, USDA and the following associates who are all professional agricultural economists. **Ronald D. Krenz, Rudie W. Slaughter, W. Herbert Brown, Percy Leo Strickland, Jerry A. Sharples, Otto C. Doering, Thomas A. Miller, Milton H. Ericksen, Leroy C. Rude, Alan S. Walter, Cecil W. Davison, Rodney L. Walker, Ludwin D. Speir, Jr., Thomas A. Stucker, James D. Johnson, Ronald R. Miller, Charles C. Micheel, Ronald L. Meekhof,** and **Gail D. Garst.** "Agricultural Policy Analysis Program Area."

Distinguished Undergraduate Teaching

Less than ten years. **Thomas L. Frey**, University of Illinois.

Ten years or more. **Daniel G. Sisler**, Cornell University.

Outstanding Master's Degree Program

Robert Phillip King. "An Analysis of Rural Consumption Patterns in Sierra Leone and Their Employment and Growth Effects." Michigan State University (adviser: Derek Byerlee).

Outstanding Doctoral Degree Program

Alexander Hippocrates Sarris. "The Economics of International Grain Reserve Systems." Massachusetts Institute of Technology (adviser: Lance Taylor).
David John Walker. "Economic Analysis of Alternative Resource and Environmental Policies for Controlling Soil Loss and Sedimentation." Iowa State University (adviser: John F. Timmons).
Frank A. Ward. "The Welfare Effects of a Market Allocation of an Exhaustible Resource." Colorado State University (adviser: John R. McKean).

Quality of Research Discovery

Wallace E. Huffman. "Allocative Efficiency: The Role of Human Capital." *Quart. J. Econ.* 91 (1977): 59–80.
Gershon Feder, Richard Just, and Andrew Schmitz. "Storage With Price Uncertainty in International Trade." *Internat. Econ. Rev.* 13(1977):553–68.
Honorable mention: Wallace E. Tyner, Robert J. Kalter, and John P. Wold. "Western Coal: Promise or Problem?" Cornell University Agr. Econ. Dep. AE Res. Bull. No. 77–13. Aug. 1977.
Honorable mention: Oscar R. Burt and Ronald G. Cummings. "Natural Resource Management, The Steady State and Approximately Optimal Decision Rules." *Land Econ.* 53(1977):1–72.

Quality of Communication

David H. Bache and James R. Foster. "Pork Product Systems with Business Analysis." Purdue University Cooperative Extension Service, 1976.
Stanley A. Changnon, Jr., Ray Jay Davis, Barbara C. Farher, J. Eugene Hass, J. Loreena Ivens, Martin V. Jones, Donald A. Klein, Dean Mann, Griffith M. Morgan, Jr., Steven T. Sonka, Earl R. Swanson, C. Robert Taylor, Jon Van Blokland. "Hail Suppression: Impacts and Issues." Urbana: Illinois State University, April 1977; and "Hail Suppression and Society: Summary of Technology Assessment of Hail Suppression." Urbana: Illinois State University, June 1977.
Honorable mention: Agricultural Extension Service, University of Minnesota. "Minnesota Agricultural Economist," ten separate pamphlets, Nos. 585–594, June 1977–Nov.-Dec. 1977.
Honorable mention: Harold G. Halcrow. *Food Policy for America.* New York: McGraw-Hill Book Co., 1977.

Publication of Enduring Quality

John W. Mellor, Department of State, Washington, D.C. *The Economics of Agricultural Development.* Cornell University Press, 1966.

Outstanding Journal Article

Yujiro Hayami and Robert W. Herdt. "Market Price Effects of Technological Change on Income Distribution in Semisubsistence Agriculture." *Amer. J. Agr. Econ.* 59(1977):245–56.

Special Recognition, 1977 Winner, Edward W. Browning Award

Earl O. Heady, professor, Iowa State University.

A. Gordon Ball, chairman

Report of Committee on Publication of Postwar Literature Review

As of 15 June 1978 sales of volume I of the *Review* were 1,120, of which 537 were to AAEA members. Sales of volume II were 691, of which 351 were to AAEA members. Total royalties on nonmember sales paid or due the AAEA were $4,000. The committee will negotiate terms of an agreement for volume III after its acceptance and make recommendations to the Board.

Emerson M. Babb, chairman

Report of Literature Retrieval Committee

The Literature Retrieval Committee has carried on its planning and other activities through correspondence and telephone. Several committee members have visited the Documentation Retrieval Center in Washington. Others have talked with Gerald Ogden and Cynthia Kenyon at the demonstrations they have been giving at major meetings of agricultural economics organizations. The demonstrations, financed by ESCS, have been helpful in encouraging agricultural economists to send their publications, with abstracts, to the American Agricultural Economics Documentation Center, although much remains to be done.

Members of the committee have been active in securing interested cooperators at the land grant universities and other institutions. This task, because of changes in the departments at the universities and changes in interest, requires constant effort. The director of the Center assists in this, making many contacts directly with the departments in the universities. The Documentation Center is now receiving 27% more documents each month than it was a year ago and is adding citations at a rate of 2,500 per year. In addition, the Center has arranged to make citations on Canadian cooperatives available on-line.

New hardware and software will soon be available to the Center. Input can be increased as much as 25%, but to do so will require an indexer-cataloger to assist in preparing citations for input.

Essentially, we believe that the Documentation Center is now operating at peak efficiency with its staff of one full-time professional and two part-time library technicians.

The committee was pleased with the letter sent out by President Hildreth, calling attention of AAEA members to the possible usefulness of the documentation file. Neither the committee nor the Center have determined the use of the data base profession wide. However, the ESCS since November 1977, reports a steady increase in search requests. These are now running about 500 a year. The availability of abstracts seems to be particularly useful. The Center director plans to determine more exactly what libraries offer retrieval services and to make this available.

The most important future activity by the committee may be encouraging agricultural economists, particularly graduate students and those engaged in serious research, to use the material now available. The file is now large enough that it should be of considerable help to any researcher in locating pertinent research published in the past few years.

The committee urges that the American Agricultural Economics Association increase its funding for the coming year from $15,000 to $27,000. This will permit the hiring of the badly needed indexer-cataloger.

The committee also recommends that the Literature Retrieval Committee be extended, with a new chairman and some rotation in the membership. In addition, the Committee recommends further discussions with the Canadian groups and with WAERSA to provide additional service and to eliminate duplicating efforts.

Wayne D. Rasmussen, chairman

Report of the Professional Activities Committee

This committee conducted business during the entire year. Although most activity occurred at a two-day meeting in late April, there was a constant flow of information, questions, responses, and opinions among committee members as well as between the committee and officers of the Association. Most time was spent on issues related to committee-sponsored sessions at the annual meeting, sponsorship of symposia, accreditation and certification of members, the quality of undergraduate instruction, and the future of the Association.

Many recommendations were made about specific topics during the year. Recommendations to be made to the Board at its August meeting include: (*a*) That the Association pursue some of the public-awareness opportunities offered through NSF. (*b*) That the Resident Instruction Committee be asked to develop a prototype symposium or series of symposia to assist in upgrading the skills of teachers of agricultural economics. These symposia should be self-financing but should be maintained under the auspices of the Association. The first symposium should be available within two years and, if possible, should he held on the campus of a non-land grant school. (*c*) That the program of the 1979 summer meeting include an invited paper session on the supply and demand for agricultural economists. (*d*) That the Association adopt the practice of using a program of small but frequent increases in dues. (*e*) That the Association establish an ad hoc committee to inquire into the feasibility of making a health and/or life insurance program available to members. (*f*) That the Association form a program committee to assist the Association President develop the program for the annual meeting. The program committee should have a tentative program available for publication in the February issue of the *Journal*.

The Professional Activities Committee will continue to deliberate problems concerning the future of the Association. The coming year will require an intensive examination of the constitution and by-laws as well as an inquiry into the appropriateness of recognizing subdisciplines in planning the Association's activities.

Paul W. Barkley, chairman

Report of the Economic Statistics Committee

Proceedings of the Agricultural and Rural Data workshop were released in two parts: Series A—Price Reporting and Capacity of the Food and Fiber Systems, published by the Statistical Reporting Service, USDA; Series B—Indicators of Well-being of People Engaged in Farming and Data for Farm and Rural Employment, published by the Economics, Statistics and Cooperatives Service, USDA. Proceedings from Series B provided basic background for the National Commission on Employment and Unemployment Statistics.

The Economic Statistics Committee sent letters to the Bureau of the Census, Office of Management and Budget, and USDA urging that detail in federal statistics for agricultural and rural areas be retained.

Three task forces were appointed to analyze conceptual, operational, and implementation issues in the following areas: (*a*) the economic value of statistical information—Bruce Bullock (chairman), Ozzie Blaich, James Olson, Richard Shumway, Peter Emerson, and Willis Peterson; administrative advisor William Kibler. (*b*) measurement of agricultural productivity—Bruce Gardner (chairman), Don Durost, William Lin, Glenn Nelson, and Norman Whittlesey; Y. C. Lu, consultant, and John Lee, administrative advisor. (*c*) agricultural outlook—John Ikerd (chairman), Bruce Scherr, Rex Daly, Gene Futrell, and John Ferris. Each of these task forces has met several times, has made considerable progress, and will present a report of its work to the Association in symposium sessions at the AAEA meeting in Blacksburg, Virginia.

The Committee met at the annual AAEA meetings in San Diego and, again, in Washington, D.C. on 20 April to monitor current progress and outline future plans. At the latter meeting, the committee deemed that consolidation of present activities and implementation of previous work was of greater priority than a major thrust into new areas of work.

Luther G. Tweeten, chairman

Report of the Committee on Management, Structure, Methods, and Procedures

This committee was established about 1 April 1977 by then President Farrell and asked to undertake an assignment with three principal objectives: (*a*) review the management structure, methods, and procedures of the Association and make recommendations to enhance the quality of services to members and the efficiency in operations of the Association, (*b*) examine the feasibility of establishing a permanent AAEA executive office for program management, and (*c*) as required under our bylaws review the performance of the secretary-treasurer during the past three to five years.

The committee has worked on all three objectives. It has completed the third objective and will file a report on it. It has mounted a major survey of all Association committees, boards, and officers since 1971 in support of the first objective, and has initiated inquiry with other professional associations on the second objective in order to determine program management procedures which they use and to ascertain the pros and cons of such procedures.

The committee will present an interim report to the Executive Board at the summer meetings at Blacksburg and will present a final report by 15 November 1978.

W. B. Sundquist, chairman

Report of the Professional Registries and Employment Committee

At the San Diego meeting, the Board took action to combine the Employment Committee with the Professional Registries Committee and adopted a proposal developed by the Professional Registries Committee for cooperative operation of the Registry for Agricultural Economists (RAE) with the USDA-ESCS once the grant period with the Department of Labor expired.

Funding for the Registry would have come from ESCS and other employer-users and would have been coordinated by the Association. Shortly after the Board's action, an offer was received from the Illinois State Employment Service (ISES) for continued operation of the Registry (with advisory cooperation from the Association) for as long as the project remains productive. The Board accepted the offer, because it offered the possibility of longer run stability of operation of the Registry at a small cost to the Association. The committee worked with President Hildreth in developing a Memorandum of Agreement with ISES. Operation of RAE was assumed by ISES on 16 February 1978. In accordance with the Memorandum of Agreement, President Hildreth appointed a Registry Advisory Committee to meet periodically with representatives of ISES and discuss items of mutual concern regarding RAE.

The Professional Registries and Employment Committee met in Chicago in April with 100% attendance of its twelve members. The agenda included discussion of the new agreement with ISES, completion of the final report to the Department of Labor, and preparation of a recommendation to the Board regarding future handbook-directories.

The committee recommends that future handbook-directories be prepared with camera-ready copies from RAE. This is an item which has been under study by this committee and the previous Employment Committee at the request of the Board. A survey was conducted by the Employment Committee to determine what items Association members felt should be included in a handbook. The survey results were presented to the Board at its San Diego meeting. Based on the survey, the committee recommends including the following membership items on each professional listed in the handbook: name, address/telephone number, rank or title, current employer, previous employers (3), nature of current employment activity (e.g., teaching, research, etc.), field of specialization, colleges or universities attended, degrees held and years granted, year of birth, and citizenship, and the following general information: classification of members by fields of specialization and a geographic list of members.

Because the Registry has multiple uses to the profession (in addition to its use for employment purposes), it is necessary to have as many agricultural economists registered as possible. Uses in addition to employment include developing a data base for handbook purposes and for use in educational planning regarding the profession. Thus, it is not essential for a person to be available for employment in order to be registered. New procedures were developed by the committee to assure persons who wish to register for purposes other than employment that their names and resumes will not be referred to employers. In an effort to encourage as large a registration of professionals as possible, the committee prepared and distributed promotional materials explaining the multiple-use aspects of the Registry.

The Registry continues to receive heavy use for employment purposes as suggested by the following statistics:

Number	7/1/76 to 6/30/77	7/1/77 to 6/30/78
Active job openings (as of 6/30)	192	222
New jobs listed during the year	278	238
Persons registered (as of 6/30)	2,232	2,368
Persons placed with RAE assistance (as of 6/30)	96	123
Placements per month	8.00	10.25

Employment services will again be provided at the 1978 AAEA meeting in Blacksburg as an extension of year-round RAE services. Sandra Batie is serving as local coordinator for employment services for the V.P.I. meeting.

The Association's grant period with the U.S. Department of Labor has been extended to 30 December 1978. During this time, the committee will prepare its final report and evaluation of the project for presentation to the Department of Labor.

David Boyne, chairman

Report of the Membership Committee

Membership in AAEA has reached a new high. This achievement is undoubtedly the result of many factors and the efforts of many members. In particular, we want to pay tribute to John E. Lee, Jr., immediate past chairman of the membership committee, and to his committee members. It was Lee's leadership that put sound long-range planning and a new organizational structure in the committee. Building and maintaining membership is a perpetual process. We encourage future AAEA boards to nurture the continued development and contributions of this committee.

In 1977–78, the committee continued to function primarily through the target group approach, although we end the year without leadership in two of the target areas. The essence of this organization is that ten groups have been identified where a committee member could concentrate his/her efforts. Five regional groups are identified—Northeastern, Southern, North Central, Western, and Canadian. The nonregional groups are: 1890 land-grant and related institutions, non-land grant educational institutions, industry, nonprofit institutions, and federal agencies. We encourage the continued cooperation of AAEA and the regional groups through joint appointment of regional target group chairmen for three-year terms. Other committee appointments should be specifically to fill vacancies associated with target groups. I propose the industry target group chairman be the member of the industry committee having responsibility for institutional members, to strengthen the liaison between the membership and industry committees.

Rounding out the committee are a representative of the Board and the secretary-treasurer of AAEA. The circulation of the membership information leaflet has continued, some through contact with department chairmen and some distribution at a regional meeting. One variation of this distribution has been preparation of a promotional letter/flyer that could be xeroxed and distributed by a contact person at a given institution. With other target groups, personal contact has been most useful. For example, Reed Hertford, of the Ford Foundation, has made efforts to promote membership through contacts he has with other nonprofit institutions.

John Redman and his staff continue to contact past members who fail to rejoin the Association. This means that once a new member goes on the rolls, there will be continued contact with that person, even though membership lapses. The addition of a word-processing machine will further enhance this type of effort by our secretary-treasurer.

A concern for increasing institutional membership has been expressed previously. John Redman reports little change in size of that membership during the past year. The challenge to the Association lies in, first, making such membership beneficial, and next, developing a list of potential members and a procedure to effectively contact such prospects. I suggest we give our institutional members more exposure, so membership becomes one more means of advertising. The industry committee and membership committee should coordinate efforts on increasing institutional memberships.

It was reported one year ago that a computer tape and retrieval program for a master list of AAEA members was developed. Loyd Martin played a key role in helping achieve this. Data gathered for compiling the handbook was the basis of the tape. The system is not tied to the ongoing paid-up membership list that develops on a week-by-week basis at the secretary-treasurers office. The major concern still unsolved is how to maintain and update the tape. To be most useful, we need to be able to provide each target group chairman with a list of AAEA members for his target group. A special recruitment program could then be directed toward nonmembers, and it would be possible to monitor progress or lack thereof. As it is, each target chairman "shoots in the dark" without knowing what such membership was before or after his efforts. If the Association wishes to go further to increase membership, it seems imperative that we develop the capacity to produce membership lists by target area.

The membership committee is aware that a special committee on "Management, Structure, Methods, and Procedures" is evaluating the automation alternatives. Therefore, we have made no moves this past year, awaiting results of study by that committee. The membership committee would appreciate input from the Board related to this matter. We can remain in "hold" pattern, or we can move ahead to explore a procedure for updating and using the computer tapes. To update would most likely require going back to USDA and requesting additional assistance from them to accomplish the task.

The question has been referred to the committee on whether a "family membership" plan should be offered. This issue will be presented to the committee as a whole on 7 August.

The membership committee will meet 7 August to evaluate past efforts and chart a course for the year ahead. A major focus will be to develop goals, strategies, and a plan of action for each target group. We will review experience and suggestions on the joint appointment of AAEA and regional membership chairmen. As groups, graduate students and institutions will be singly discussed. The membership tapes will be discussed, hopefully with benefit of input from the Board to this committee—not only on the tapes but on other relevant suggestions.

Thomas L. Frey, chairman

Report of the Industry Affairs Committee

The primary purpose of the Industry Affairs Committee is to promote the interests of the profession and the selective interest of the economists within the framework of the AAEA.

Within the framework of the above purpose the Industry Affairs Committee activities in 1978 will include: (*a*) sponsoring an industry banquet and symposia at the annual meeting in Blacksburg, Virginia, (*b*) prepare a list of industry economists who are willing to give seminars at universities, (*c*) increase industry membership and participation in the Association, and (*d*) promote academic research interests in industry problems.

Richard Lyng, president of the American Meat Institute has accepted an invitation to speak at the summer meeting of the AAEA. The banquet is scheduled for 7 August at the Marriott Motor Inn.

In past months we have accumulated a file on industry seminars at universities. Our intent is to classify these economists by region and then provide universities in each region with the appropriate portfolio. We are also making preparation to supply an individual speaker on a monthly or quarterly basis.

As part of the 1978 program the Industry Affairs Committee will continue the responsibility for soliciting new institutional members and assisting John Redman in handling billing requirements. The committee is also preparing ideas on what the AAEA can do to maintain the interest of industry members.

Walter M. Myers, chairman

Report of the International Committee

The International Committee's major accomplishment was to develop a proposal and obtain AID funding for a one and one-half year project entitled, "Needs and Strategies for Improving Training of Agricultural Economists for Work in International Agricultural Development." The project leader is Dr. Darrell Fienup who will carry out the study under the direction of the International Committee. The study builds on a 1973–74 study sponsored by the AAEA and the Agricultural Development Council. Both mail and personal interview surveys will be made of the U.S. trained LDC professionals. Recently trained U.S. professionals who are interested in international development careers will also be included in the study. Preliminary results of the study will be presented at the AAEA annual meeting in 1979 and a special workshop is being planned in conjunction with the 1979 meetings of the International Association of Agricultural Economists. The International Committee has provided advice and encouragement to Russ Stevenson who has recently updated his earlier survey of U.S. universities with graduate training programs for foreign students preparing for careers as agricultural economists.

Other activities of the International Committee were as follows: arranged the international dinner and an organized symposium for the 1978 meeting at VPI, provided active support for an extension of AID funding of the ADC/RTN, initiated efforts to identify ways to improve the usefulness of the AAEA Employment Registry in the recruitment of professionals for international positions and short-term assignments, and maintained a liaison with the Title 12 program.

The primary activity of the committee in 1978–79 will be to carry out the reassessment of training needs and to arrange related follow up through workshops and publications.

Harold M. Riley, chairman

Report of the Resident Instruction Committee

This committee, charged by the president and Board with four responsibilities, submits the following reports.

(*a*) To plan, organize, and conduct the undergraduate student activities at the annual meetings, the committee followed the same format utilized at last year's annual meeting. Students were invited and encouraged to submit papers to either a contributed papers session, or a "special" undergraduate contributed papers session which was chaired by Lee and Narrie. The committee recommends continued and full support of this professional program by all AAEA members.

(*b*) To assist the president in planning, organizing, and conducting a session dealing with pertinent issues in resident instruction at the annual meetings, the committee has organized an invited papers session, "Innovations in Undergraduate and Extension Teaching." No change is recommended for next year.

(*c*) To determine the "needs" of Bachelor of Science graduates in agricultural economics relative to the professional organization of AAEA. There was great diversity within the committee with regard to this task. Some of the committee were concerned about the specific symptoms of this perceived problem. This group felt that we may be creating "services" for which a demand does not exist. Three institutions are actively engaged in utilizing B.S. graduates to update their current undergraduate program. These institutions would be willing to explore the possible needs perceived by graduates which AAEA might fulfill. The committee chose to postpone any conclusions at this time, and recommends that the committee be charged to pursue this issue for at least another year.

(*d*) In order to examine AAEA bylaws relative to undergraduate participation in formal meetings, the committee reviewed the bylaws and did not foresee any problem relative to the functioning of individual (local) student organizations. However, some possible problems were foreseen with respect to the national student organization (AAEA-SS) working within the bylaws. The main concern is the lack of participation by local organizations during any given year, and the fact that the national may never have a quorum to facilitate decision making. The committee requests that the AAEA-SS president submit an annual report which includes a summary of institutions participating, the financial status of the student organization, and an indication of the ability of the present student organization to work within the present bylaws. In addition, the committee requests any specific concerns of the Board relative to the bylaws. It is recommended that the committee be specifically charged during the coming year to obtain the information described above and to analyze the reasonableness of the bylaws.

Carl O'Connor, chairman

Report of the Extension Affairs Committee

Extension Affairs Committee activities this year have focused on two areas: a follow-up to last year's survey of Extension economists and an additional survey to further identify Extension concerns about the *Journal.*

The follow-up took several forms. An ad hoc evening session on "Extension Economists and the AAEA" was held at the National Public Policy Education Conference in September 1977. Norbert Dorow prepared summaries of the 1977 survey for distribution to Extension economists. Bob Christensen has submitted an article to the *Journal* based on the findings of the survey.

The additional survey grew out of comments on last year's survey indicating general dissatisfaction with both published *Journal* articles and the submission of articles for publication in the *Journal.* After Jim Rhodes saw the survey results he asked us to do a more specific survey to more closely identify some of these concerns as well as get some Extension thoughts on the new newsletter.

W. Fred Woods, chairman

Report of the Contributed Papers Committee

Ninety-four contributed papers were presented in nineteen sessions at the 1978 annual meetings. The range of topics covered the entire field of agricultural economics. Nearly 190 papers were submitted from all over the world.

The committee's task in 1978 was simplified by the legacy of the 1977 committee. This legacy included counsel and a valuable file transferred from last year's chairman, and a continuation of a large proportion of the membership.

The call for papers listed all the rules for submission including length, abstract, biographical sketch, number of copies, deadline for submission, AAEA membership, submission of multiple papers, publication prior to August 1978, and so on; yet, each rule was violated several times. These violations made logging-in a larger job than it needed to be. Perhaps the call for papers in 1979 should include a checklist which the authors must include with their submissions.

The quality of accepted papers this year was considered very good. Yet, some problems of quality control continue to plague the committee. Reviewers reached a consensus quickly on about 20% of the papers which were of very high caliber and on another 20% which were clearly unacceptable. Because of this, a few relatively weak papers were accepted and a few relatively strong ones rejected.

Last year's committee gave a good deal of attention to this quality control problem, but neither they nor we have solved it. If there were time for feedback among the three reviewers and a second opinion, better consensus could be achieved; but this year's committee was located in various parts of the United States and Canada and had no time for exchange after the initial review of each paper. Improved consensus would require an earlier submission date than 1 April so that each committee member would have time to rate each paper twice.

As an alternative, a technique commonly used in Delphi process might be tried: each reviewer evaluates the degree of confidence in the rating he or she assigns to each paper, and scores are then weighted by the reviewer's confidence in the rating assigned.

The committee began with ten members in addition to the chairman. An eleventh, John Graham, volunteered to represent Canada on the committee. Each member had to review about fifty papers—a heavy load. Some members delegated reviews to friends and colleagues whose contributions are not officially recognized. Others carried the burden alone. Thirty papers per reviewer would be more reasonable. If committee members are to do the reviewing, it is recommended that the membership be expanded.

Clark Edwards, chairman

Report of the Advisory Committee for the Census of Agriculture

The Advisory Committee met in October 1977 and again in April 1978. Both meetings were concerned chiefly with development of plans for the 1978 Census of Agriculture. Last fall we spent most of our time considering a lengthy list of options regarding subject matter to include on the 1978 questionnaires and the relative effectiveness for different designs of questionnaires. At the spring meeting, we reviewed the results of field tests of the questionnaires and made recommendations concerning the content and design of the 1978 enumeration.

The 1978 Census of Agriculture will be much better designed and planned than the 1974 effort. The schedules will be much less of a burden on respondents which, hopefully, will improve response and reduce objections from the public. This, in turn, should improve the quality of the data that are obtained. The 1978 census is considered something of an interim effort generally following traditional patterns, while substantial changes are being planned for the 1982 census. Partly at the urging of the Advisory Committee and partly as a result of the unsatisfactory experience with the 1974 census, the Census Bureau is planning a substantially improved and expanded educational campaign to accompany the 1978 enumeration. This, too, should reduce unfavorable public reaction, should improve response, and should improve the quality of data.

A couple of years ago, Congress took action to make the Census of Agriculture a member of the family of economic censuses; thus there will be a census of agriculture in 1978 (instead of 1979) and another in 1982. This will make the agriculture census concurrent with other economic censuses in the 1980s and beyond. Making these censuses concurrent is only a first step toward getting consistent information about the farming sector, other sectors of agriculture, and other sectors of the economy. I worked for the Bureau a few months last fall trying to develop recommendations that would help achieve consistency among the census of agriculture, census of manufacturing (food and kindred products), census of wholesale trade, census of agricultural services, and county business patterns. Making the family of economic censuses concurrent gives the Bureau the opportunity to correct some inconsistencies among different sources of data. What actions the Bureau will actually take by 1982 remains to be seen.

M. L. Upchurch, chairman

Report of the Agricultural Statistics Committee of Federal Statistics Users' Conference

The Federal Statistics Users' Conference Agricultural Statistics Committee has continued in its third year of active operation after being reactivated in late 1975. The committee continues to operate under established objectives which emphasize the improvement of communications between users and producers of federal statistics and the improving of quality and timeliness of statistics.

Activities during the past year have included the following. (*a*) A forum discussion of agricultural statistics was held at the twenty-first annual meeting of the Federal Statistics Users' Conference in Washington, D.C. Discussants included key members from the USDA and Department of Commerce statistics-producing areas. This forum provided the opportunity for statistics users to acquire a greater understanding of the federal statistical system and of the review and evaluation efforts being made to improve the system and its products. (*b*) The Federal Statistics Users Agricultural Committee held a one-day meeting in May 1978 with representatives of major user and producer groups from various branches of the federal government. The purpose of the meeting was to discuss data-producer plans for the year ahead and to present data-user requirements and suggestions for additions, deletions, and direction relative to federal statistics. (*c*) The committee responded to a number of proposed changes in federal statistics and also reviewed the paper, "A Framework For Planning U.S. Federal Statistics 1978–89."

Plans for 1978–79 include a continuation of the annual meeting with key government producers and users of federal statistics. Also, the committee will continue to evaluate federal statistics programs and proposed changes and offer recommendations.

Norman M. Coats, chairman

Report of the Committee to Evaluate the Annual Meetings Programs

The committee obtained information from five sources: (*a*) the Association constitution and bylaws, presidential reports and minutes of meetings, (*b*) evaluation forms completed by the chairperson and by one appointed observer for each of the sessions for the meetings at Pennsylvania State and San Diego, (*c*) a specially designed questionnaire sent to all persons listed as members in early 1977, (*d*) a specially designed questionnaire sent to persons who had been members in 1970, but who had dropped membership by 1977, and (*e*) a centerfold questionnaire used at the San Diego meeting.

Based on the responses of persons in these five population groups, the committee has prepared the following tentative summary and conclusions.

(*a*) There is no overwhelming evidence to indicate the need for substantial changes in any aspect of the annual program.

(*b*) If the program committee wishes to have greater membership attendance and participation, it will have to broaden its appeal and diversify the program. It can design sessions for the less than traditional interests, such as marine economics, forestry economics, administrator concerns, and those of such groups as extension, personnel, and farmers. The program committee also can try to attract a larger number of the typical members by concentrating on the aspects they prefer, and by examining the possibilities of overcoming the opposition that some members and former members have to the *Journal*.

(*c*) The preference for location of a meeting place prior to the San Diego meeting was for a university setting. Those in attendance at San Diego who answered the questionnaire indicated a willingness to meet in commercial facilities. Logical reasoning could lead to the conclusion that the kind and quality of available facilities are more important than the location. Because many bring their families to the meeting, treat the experience as a quasi-vacation time, and place considerable emphasis on the informal socializing aspects of the meeting, a setting that would provide an atmosphere complementary to these felt needs and that is not too expensive would be acceptable.

(*d*) There is a positive relationship between attendance and participation in any of the activities of the Association; therefore, broader participation should be encouraged.

(*e*) The interest in informal sessions, such as the concept of the symposia, is relatively high. When operated in accordance with guidelines such sessions can be successful. Organizers should avoid creating a "closed club" impression and should set aside at least half of the time for free and open discussion. In response to the request for more discussion, the leader must accept the risk of unused time.

(*f*) There are certain aspects that will always require close, detailed, and persistent attention. These include a closer control of time by the chairperson and speakers; presentations at the less formal sessions in the form of discussion or ad lib articulation rather than the reading of papers; the provision of adequate time for discussion periods; the availability of good quality, operable audiovisual equipment and the proper use of it by speakers; and better matching of room size with size of potential audience. For an organized session with more than one presentation, there should be comparability or complementarity of subject matter, and at all sessions there must be an emphasis upon articulation and enunciation for effective communication with audience.

(*g*) In those sessions which provide for discussion and in which more than one paper is presented, the chairperson should provide time for questions and discussion following each paper—provisions for discussion should not be delayed until the end. This will require strict adherance to a specific timetable.

(*h*) The evaluation of sessions by the chairperson probably should become routine and be a responsibility of the program committee.

(*i*) The use of an evaluation form of the type used at San Diego should be used rather frequently if not each year for the benefit of the program committee for the coming year.

(*j*) In addition, there are some ideas that should receive the attention of the Board because they are conceivably emerging issues. The Board should consider starting the meeting on Monday evening to avoid traveling on Sunday, and the lengthening of the meeting to reduce crowding of sessions. An examination perhaps should be made of the motivation of members to attend the annual meeting and their motivation for supporting and reading the *Journal*. Also, it may be of no value, and perhaps even detrimental, for participants in certain types of sessions to realize their discussions will be published in the *Journal*.

(*k*) Careful study of the "comments" section of the centerfold questionnaire and of the comments made in the session evaluation and by chairpersons may help to "fine tune" next year's program.

Henry J. Meenan, chairman

Report of the Alternative Publications Committee

The committee considered several alternatives which could, individually or in some combination, feasibly and more efficiently serve the needs of the membership while maintaining the *Journal* as a high-quality scientific publication.

Alternatives Considered—Pro and Con

Newsletter. If the *Journal* should provide primarily for publication and preservation of scientific material either in personal or public libraries or other repositories, then much of the material of current interest such as News Notes presently included in the *Journal* could be disseminated in a newsletter or some similar publication.

An estimated 4,000 copies of the newsletter (rather than 7,000 as with the *Journal*) could be printed and mailed to the membership quarterly. It could be printed from typewritten, camera-ready copy by xerographic or other processes and mailed under the Association's second class permit.

All items included in the 11% (122 pages) miscellany of the 1,110 page *Journal* in 1976–77 should not be transferred to the newsletter, however. Abstracts of contributed papers, book reviews, the index, and lists of dissertations (not unanimous agreement by committee about book reviews and dissertation lists) should remain in the *Journal*. Transfer of about 80 pages per year of the miscellaneous material to the newsletter is the more likely alternative. Providing for increased communications and other material would require an estimated 120 pages per year for the newsletter. Publications of abstracts of contributed papers in the *Journal* would be essential if the proposal that they be provided to an abstracting service or entered through the American Agricultural Economics Documentation Center is accepted. These proposals are considered in detail below.

Dividing the Journal

One of the alternatives considered by the committee was to divide the *Journal* into two volumes, such as is done by *Management Science*. One volume would contain articles of a purely theoretical or methodological nature and the other would focus on applied studies, including articles dealing with economic policy.

Arguments advanced in favor of this alternative are that the two volumes would better accommodate the diverse interest of *Journal* readers and would provide an expanded and needed critically reviewed outlet for reporting the results of applied research.

The members of the Alternative Publications Committee do not favor splitting the *Journal* into two volumes but strongly support including reports of applied studies and articles dealing with policy issues in the *Journal*. Three reasons were advanced for opposing this change. First, many states (although perhaps not all) and the USDA currently have adequate outlets for publishing applied research results of a more fully developed nature. Second, opportunities for publishing applied studies are increasing with the expansion of regional journals, including the new *Western Journal of Agricultural Economics*. Third, because agricultural economics is to a large degree an applied discipline, it is felt that some difficulty would be encountered in determining whether studies belong in the theory-methodological or applied volume. The committee, therefore, advocates continuation of the traditional structure of the *Journal* which intermixes both applied studies and theoretically or methodologically oriented articles.

Journal of Agricultural Economics Literature. Some interest has been expressed in reviewing agricultural economics literature in a manner similar to the *Journal of Economic Literature*. The AAEA has just completed and is in the process of publishing the *Postwar Literature Review* volumes. In addition, the editor has commissioned several special articles for publication in *AJAE*. Hence, in the opinion of this committee, one or two special reviews per year should be sufficient presently. We recommend that such reviews be commissioned by future editors and that they be so identified when published in *AJAE*.

Publication of Proceedings. Another alternative considered by the committee was to publish the proceedings of the joint meeting with AEA and the AAEA summer meeting in one volume, separate from the *Journal*, with the proceedings priced separately except to libraries. The price quoted libraries would include the *Journal* and the proceedings. Otherwise, it would be purchased at the time of registration for the annual meetings, at the time of sending in dues, or for a short time after the meetings. A limited number in excess of the number purchased would be published for later sale. Invited papers would be published in full; contributed papers would be published as abstracts with page limitations (possibly up to ten pages).

Because most annual meetings are organized around subjects of topical interest to the members, these papers provide the members and the public with the latest professional thinking on the current policy and professional issues. Thus, these papers should be of interest to the researcher, teacher, extension worker, business economist, and the general public. Proceedings volumes present the broadest cross-section of thinking of the profession. They should be improved to meet the needs of a greater number of interests. These volumes should stand on their merits and have an independent financial base to meet broader demands of the profession. Many people are not aware of the breadth of interest or the competencies of members in the profession. With limited advertising, they would be of interest to other professional groups. The *Journal* Committee has had testimony that the proceedings has a broader and more general audience than the *Journal*.

The pages released in the *Journal* could be used to publish a broader spectrum of manuscripts.

Arguments against publication of the proceedings separately generally imply that the papers are not of the same quality as those in the peer-reviewed *Journal*. Therefore, we should not publish everything which is presented in whole or in part at the two professional meetings of the Association. Proceedings publications should be held to a minimum since they do not represent new frontier thinking selected on a competitive basis.

If the proceedings issue were priced separately, for say $10, people would not buy it.

Furthermore, if the recommendations presented later in this report on utilization of the Agricultural Economics Documentation Center were implemented, full copies of all papers would be available to the membership and other users upon request, thus negating much of the need for a separate publication.

Popularized-type Publication. The committee recognized that there is a potential membership for the Association of individuals with bachelor of science degrees and others not directly involved in academic and/or the Land Grant government spheres who could be served by a popularized publication modeled after that published by the American Society of Agronomy. The committee has not thoroughly analyzed this alternative and, due to such aspects as publication complexities, potential costs, and membership ramifications, recommends that a separate committee be established with the specific mission of examining this alternative.

Microfilm and Microfiche. This committee supports the proposal of the Professional Activities Committee which included the study of opportunities in this area and has established liaison with Gene Wunderlich in reference to the proposed study. Further consideration of this alternative by this committee is not anticipated.

Utilization of Abstracting Services. The committee was given the responsibility of evaluating the proposal presented by Redman concerning procedures for preserving and retrieving copies of contributed papers and other papers presented at seminars, conferences, etc. Abstracts of contributed papers are published in the *Journal* now and AAEA has a contract with University Microfilms to put the *Journal* on microfilm. In addition, bibliographic references to articles in the *Journal* are entered through the American Agricultural Economics Documentation Center into AGRICOLA, the National Agricultural Library computerized system. While abstracts of manuscripts other than contributed papers are not published in the *Journal*, it would appear that the procedure described below would be the better of the alternatives proposed. Full copies of all papers would be available upon request from AAEDC, and contributed papers would continue to be "advertised" in the *Journal*.

This committee recommends that procedures be established by the editor, the secretary-treasurer, or others designated by the Board to collect complete copies of all contributed and symposia papers and provide them to the American Agricultural Economics Documentation Center for entry into the system. Copies could also be placed with University Microfilms on a no-cost basis. Notations to the effect that copies of the full text of papers are available from these sources should be made in the *Journal* where the abstracts are published.

Survey of Membership

The AAEA Publication(s) Opinion Survey questionnaire was mailed to the membership in May 1977. A total of 407 questionnaires were returned and analyzed. Respondents rated five publication alternatives on a scale from 1 to 6. The lower the score, the higher was their preference. (A detailed analysis of the responses is available from the chairman upon request.)

These results of the survey indicate the respondents want a change in the publications of the Association. Because both options B and C would include a separate newsletter, issued quarterly, and in addition incorporate items now reported in the present *Journal*, some experimentation with a separate newsletter of this character would be welcomed by a majority of the respondents, and probably by the entire membership.

The close scores for options B and C, however, do not provide a basis for a clear-cut choice between them. Option C would require the greatest amount of change and would be the most costly. The editors would have to develop a classification allocating manuscripts toward either *Journal A* or

Table 1. Summary of Publication Preferences

Publication Alternatives	Proportion of Responses with Evaluation of 1,2	1,2,3	Mean	Standard Deviation	Median	Mode
	%	%	Rank Scores	Rank Scores	Rank Scores	Rank Scores
A	27.2	48.8	3.59	1.61	3.58	5
B	47.5	69.5	2.84	1.36	2.61	2
C	50.9	58.0	2.95	1.90	2.43	1
D	37.2	52.4	3.29	1.59	3.43	4
E	26.3	52.1	3.43	1.41	3.42	3

Note: A—The *Journal* as it is presently. B—The *Journal* plus a quarterly newsletter; the *Journal* to contain professional papers and articles, the newsletter to contain other material such as news notes, AAEA business, etc., now included in the *Journal* plus additional material. C—Divide the *Journal* into two volumes, plus newsletter. Volume A would cover theory and methodology. Volume B would cover applied studies including economic policy. Newsletter would be similar to (B) above. D—One *Journal* and newsletter as in (B), plus a *Journal of Agricultural Economics Literature* (similar to *Journal of Economic Literature*'s survey articles, and bibliographic material) published in a separate volume. E—One *Journal* and newsletter as in (B) but with Proceedings of Annual Meeting published separately.

Journal B. While the *Journal of Marketing* and the *Journal of Marketing Research* provide an analogous example, the membership of the American Marketing Association is larger, and historically has chosen to give both *Journals* substantially more monetary support than our members have given the *American Journal of Agricultural Economics*.

Before establishing an additional *Journal* some experimentation with the present *Journal*'s product mix and format to reflect the option C approach could be made. For instance, a distinct separation within the present *Journal* could be made by presenting all of the *Journal A*-type papers as a section, and likewise all of the *Journal B*-type articles. The flow of articles would establish the proportion of space granted to each section for any given issue.

An alternative approach would be to designate two issues for the articles which a *Journal A* would publish and two issues for *Journal B*-type articles. The proceedings issue would reflect both types as solicited and competitive type papers at annual meetings are of both kinds.

The respondents evaluations of alternative publication preferences also must be related to their responses to sections 2 and 3 of the questionnaire. In section 2, the respondents indicated their evaluation of the importance of specified functions for a professional economics journal. Each function was rated on a scale of 1 to 7, with the lower figure indicating the highest priority. Of the nine functions rated, four received a grade of 1 through 3 from at least 67% of the respondents.

These four functions were: (*a*) inform membership of major theoretical advances; (*b*) present papers which clarify troublesome aspects of doctrines; (*c*) inform members of new statistical and mathematical techniques and new applications of known methodology; and (*d*) present policy discussions of economic issues of interest to members.

The members then ranked the present *Journal*'s performance of each function. On these, the performance rating was substantially different (indicating dissatisfaction) from the rating given the importance of the functions. However, it is difficult to see why the adoption of either option B or C necessarily would raise the image of the *Journal*'s performance of these functions in the eyes of its readers. While creating a newsletter that would incorporate many of the items now reported in the *Journal* would help free space for more articles, or lower the costs for the same 1,100 pages per year, such a move would seem to have little direct impact that would improve the *Journal*'s performance of these four functions.

Consequently, the problem appears to relate directly to the articles submitted and selected for publication, and/or the selection process itself. With an adequate inventory of articles from which to select, either the present *Journal*, option B, or option C should improve upon the performance image now held by the respondents.

Consequently, the responsibility for upgrading the *Journal* primarily appears to be that of the membership. The topical focus, quality, and quantity of articles which they submit provide the foundation for the *Journal*'s performance of these functions.

Printing Cost Alternatives

The "word-processing" industry is dynamic. Today's cost data are no longer relevant six months later. Technological development is so swift and competition so intense, exact comparisons are almost impossible, particularly an exact matching of equipment capabilities. Today, some form of photocomposition linked to cold type photoreproduction appears to be most acceptable. Within a decade, some form of microfiche with a home site (in contrast to that of a library or central office) capability of providing clear Xerox-type copy could become an attractive option.

This Committee has not made a full scale investigation of what word processing systems are available and the findings presented must be treated as preliminary. A special committee that includes the editor and his staff person who would be responsible for, and who would use the equipment, should be appointed to make a more systematic and complete investigation. Since the Association has just completed arrangements for the coming three years, such a special committee should have its report available no later than a year and a half from now so that decisions could be made without any pressure. (Present arrangements required immediate renegotiation.)

Recommendations

The committee submits to the membership the following recommendations.

(*a*) That AAEA publish a newsletter quarterly totaling about 120 pages annually. The newsletter would include the miscellaneous items, except for abstracts or contributed papers, book reviews, and the index, all of which would be continued in the *Journal*. The remainder of the space in the newsletter could be utilized for communication from the officers of the Association, surveys, special reports, and selected articles. Perhaps the present length of the *Journal* could be continued with the additional space utilized to publish refereed papers.

(*b*) That the *Journal* not be divided into separate volumes for theory-methodolgy and applied studies, but that the editor be encouraged to solicit quality articles in areas of strong demand and, if feasible, emphasize specific areas in certain issues.

(*c*) That the editor continue to commission special review articles for publication in the *Journal*.

(*d*) That the practice of publishing abstracts of contributed papers in the *Journal* be continued and procedures be established for collecting complete copies of the contributed and symposia papers and entering them through the American Agricultural

Economics Documentation Center and University Microfilms. The *Journal* should note that copies of the complete papers would be available from the indicated sources upon request and for a modest fee.

(*e*) That a special committee be appointed to study the feasibility of initiating a popularized-type publication while expanding the membership to include these outside the Land Grant-government sphere.

(*f*) That the proposed study of the use of microfilm and microfiche by the Professional Activities Committee be encouraged and supported.

(*g*) That a special committee be appointed to study overall publication costs and alternative arrangements for publishing the *Journal* and/or conducting the affairs of the Association.

(*h*) That the Alternative Publications Committee be discharged upon acceptance of this report.

Verner G. Hurt, chairman

Report of the Committee on *Journal* Page Charge

The chairman reviewed the page charge discussions from the beginning to the present with the conclusion that the issue is far from settled. Philosophical and legal issues constitute the major concerns while, in practice, the page charge is working well. The page charge is being paid on most articles and notes.

The philosophical issue centers around whether or not the page charge is an appropriate way to help finance the *Journal* and other activities. A few institutions and agencies refuse to honor the page charge. A few authors have indicated they will refuse to contribute to the *AJAE* and will seek an outlet elsewhere. Although these issues are very important to those who hold them, it is the feeling of the chairman that only a tiny percentage of the contributors or potential contributors hold such strong convictions.

The most important and unresolved issue is legal. We have three alternatives.

(*a*) One alternative is to return to a mandatory page charge. To satisfy the postal regulations for a mandatory page charge, we must have in a suitable place on each article the following (or similar) wording: "The costs of publication of this article were defrayed in part by payment of page charges. This article must therefore be marked ADVERTISEMENT in accordance with 18 U.S.C. pp. 1734 solely to indicate this fact." This statement may be objectionable to many, including myself, but it would be less risky to use this statement until the page charge issue is resolved by the U.S. Postal Service.

(*b*) We can emphasize the voluntary aspect of the page charge and run a greater risk of not collecting from some institutions or agencies. It would reduce perhaps the risk of being cited for a violation of the rules. Such a statement in the *Journal* may read as: "Major support for this *Journal* is provided by page charges of $40 per printed page, or fraction thereof, payable by the supporting institution or granting agency. Payment is voluntary and does not affect acceptance, scheduling, or form of publication. Instructions for making payment are provided with galley proofs." This statement does not change the policy on "free" reprints, exemptions, etc., and that policy would be continued and stated in letters to invited speakers and other more appropriate places.

(*c*) Another alternative is a slight amendment of the present statement in the *Journal* to emphasize that the decision to publish and the form and timing of publication are made independently of whether or not the page charge is honored. Thus, the wording would be as follows: "Published contributions are subject to a page charge of $40 per printed page or fraction thereof, payable by a supporting institution or granting agency. Exemptions are granted for book reviews, the presidential address, the fellows' lecture, and those invited addresses and papers receiving written exemption from the AAEA president. Payment of page charges does not affect the choice of contributions for publication or when or the form in which they are published. If the charge is honored, 100 reprints are provided. Instructions for making payment and for requesting an exemption are provided with galley proofs."

Regardless of which of the three options is selected, it is recommended that we continue to monitor the problem and observe closely the experiences of other professional societies.

John C. Redman, chairman

Summary of Ad Hoc Committee Report on Non-Land Grant Member Services

The committee identified a number of activities which it believes would be useful to faculty members located at institutions whose primary emphasis is undergraduate teaching. These activities include sessions at the annual meeting or conferences at targeted institutions concerning instruction, curricula, improving research capabilities, developing graduate, area service and international programs.

The committee recommends support and endorsement for holding an instructional workshop for two-three days or possibly one week. The purpose of the workshop is to examine, discuss, and provide ideas for improving courses and curriculum in undergraduate agricultural economics and agribusiness programs located at institutions whose primary objective and focus is undergraduate teaching. Participants will be invited largely from this group of institutions, the conference would be held at one of these institutions, and published proceedings of the conference is planned. Support and endorsement would be in the form of appointing an appropriate committee to plan and carry out the activity, meaningful involvement of the Board and/or officers of the Association with the planning committee and the host institution, and aid from the Association (editorial and perhaps financial) in publishing the proceedings of the conference. It is our belief that this activity will develop and strengthen the discipline of agricultural economics and thereby help accomplish the goals of the Association.

In light of our original charge that we may prepare an interim report, we request that the committee continue in existence for another year in order to explore other approaches for increasing services to members located in institutions whose primary focus is undergraduate teaching.

William Herr, chairman

Liaison Report, National Bureau of Economic Research

I am now in the second year of a three-year appointment as director of the National Bureau of Economic Research (NBER). My duties as director include participation in two meetings a year, review for publication of selected manuscripts, and member of the editorial board of the *Journal of Applied Economic Research*.

The Bureau has undergone a major transition during recent years. As with many other independent research organizations, it has been subject to rather severe financial difficulties. Major pruning has been under way to put it back on a sounder financial base. Offices in both New York and Washington were closed. In their place, space has been leased from New York University for use of the New York research staff, and accounting and other corporate administrative functions have been transferred to an enlarged office in Cambridge, Massachusetts.

Staff has been reduced as necessary, and the *Journal of Applied Economic Research* has been terminated. As a partial substitute, a quarterly *NBER Reporter* has been instituted to publicize results of current research efforts and other activities. A major effort at fund recruitment also has been undertaken.

The leadership of the Bureau was changed at the meeting of April 1977. Robert Meyer of Harvard stepped down as president after distinguished service to the Bureau, and Martin Feldstein, also of Harvard, was elected in his place. Feldstein has been actively streamlining and changing the organization to adjust to its changing circumstances.

The Bureau's computer research center and computer operations activities formerly conducted in an office in Cambridge have been transferred to the Massachusetts Institute of Technology. The Bureau also discontinued the operation of its data banks and related service activities. In its place the Bureau now utilizes the much larger data banks of Data Resources, at favorable rates and without charges for the administrative costs. Data Resources also agreed to provide data bank services to the universities and other nonprofit organizations which had been NBER data bank customers at the same rates the NBER had charged.

During 1977 National Bureau book manuscripts were published by Ballinger Publishing Company. President Feldstein negotiated a contract with the University of Chicago Press for publication of future NBER book manuscripts.

The annual Conference on Income and Wealth has been an important NBER activity over the years. However, it is no longer being assisted by National Science Foundation grants for general program support. This led to a review of the role of the conference and how its operations might be served. Several NBER directors, including the undersigned, commented on the importance of the conference operations which provide a tie between people who produce economic statistics and analysts who used them and expressed the hope that the group would continue to operate with increased effectiveness.

Two conferences in this series are of special interest to agricultural economists. The first was held in Lima, Peru, on 19–23 May 1978, and dealt with "Commodity Markets, Models and Policies in Latin America." The second is tentatively planned for early 1979, and will consider "How U.S. Commercial Policy Affects Development in Latin America."

At the April 1978 meeting of the directors, the Bureau agreed to confer the honorary designation of Research Emeritus on selected, outstanding persons who had retired from active service on the NBER's research staff. This status was then conferred on Arthur F. Burns, Soloman Fabricant, Milton Friedman, Raymond W. Goldsmith, Simon Kuznets, and George J. Stigler.

To conclude, it has been a privilege to serve the Association as liaison with this important organization. There is a substantial community of interests between the Bureau and the Association, and we need to sustain strong ties.

G. Edward Schuh

Minutes

Minutes of the Executive Board Meeting

The Executive Board with Hildreth, Farrell, Barr, Lane, Raup, and Coffey, met at 1:30 p.m. on 29 September 1977 via telephone conference for the purpose of discussing the proposal by Illinois State Employment Service to assume the full responsibility for operating the Registry and provide essentially the same or improved services after the present funding terminates on 15 February 1978. The AAEA would offer advisory services to the Registry. The only financial obligation of AAEA is to provide funds for travel expense for staff to attend the annual meeting, printing forms, and publicizing the Registry.

Note was made of Article V, Section 6, of the AAEA Constitution concerning decision of the Board of this nature. The section states in part that "any action required or permitted to be taken by the Executive Board at a meeting or by resolution may be taken without a meeting if a consent in writing, setting the action so taken, shall be signed by all voting members of the Executive Board then in office."

Farrell moved that the action of the Board at the San Diego meeting to move the Registry to Washington be rescinded and that the Illinois State Employment Service proposal to operate the Registry in cooperation with the AAEA be accepted. Seconded. Passed.

Barr moved to direct the president of AAEA to negotiate a Memorandum of Understanding between the Illinois State Employment Service and the AAEA for approval by the Executive Board. Seconded. Passed.

Meeting adjourned at 2:10 p.m.

Respectfully submitted,
John C. Redman
Secretary-Treasurer

Minutes of the Executive Board Meeting, New York

The meeting was called to order by President Hildreth at 8:30 a.m., 27 December 1977.

Present: Voting members:
Hildreth, Stanton, Farrell, Coffey, Crowder, Barr, Schuh, Raup, Lane
Members ex officio:
Redman, Johnson, Tomek

1. Hildreth reviewed the agenda.

2. Lane moved the approval of minutes of the Executive Board meeting held in San Diego, California, 30–31 July 1977. Seconded. Passed.

3. Redman presented the financial report on the San Diego meeting, indicating that approximately $10,446 above expenditures were netted from the activities. Lane moved the report be accepted. Seconded. Passed.

4. Coffey presented plans for the 1978 meeting at Blacksburg. (*a*) Lane moved that a late registration fee be set at $5.00 above the regular fee with the effective date to be set by Virginia Polytechnic Institute and State University (VPI). Seconded. Passed. (*b*) Farrell moved that the Association encourage commercial book publishers and vendors of computer publishing facilities to display educational exhibits at the 1978 AAEA-CAES annual meeting at Blacksburg, Virginia, and that our experience with such exhibits be evaluated by the Professional Activities Committee with a report to the AAEA Executive Board at its meeting in December 1978. Seconded. Passed. (*c*) Crowder moved that any excess receipts over expenses associated with annual meetings hosted by public institutions be shared in a ratio of 60% for the Association and 40% for the host institution. Seconded. Passed. (*d*) Lane moved to authorize an advance of $2,000 for expenses prior to meeting at VPI and to authorize VPI to open a checking account with a local bank with authorized signatures being M. C. Conner and/or John C. Redman. Seconded. Passed. (*e*) Lane moved that registration fee at the VPI meeting be set at $15 for single members; $20 for family members; $40 for single nonmembers and $45 for family nonmembers.

5. Barkley reported for the Professional Activities Committee. Issues being considered currently include the need for the Association to identify more clearly the interests and current activities of its members, the possibility of AAEA serving as a federation for a series of smaller but more cohesive interest groups within the profession, action to provide members more opportunity in establishing research priorities, and the possibility of a program for accreditation or certification of agricultural economists. Barkley agreed to prepare a statement on accreditation and certification for inclusion in a mailing to the membership.

6. Barr reported for finance committee suggesting that adjustments in the budget adopted in San Diego in August 1977 be delayed to the final hour of the Board meeting. He presented the report of the portfolio subcommittee and moved that the "Investment Portfolio Management Procedures" be adopted. Seconded. Passed.

Barr moved that the recommendations of the portfolio subcommittee to buy 300 shares of C.I.T. Financial, 250 shares of American Cyanimid, 300 shares of Santa Fe Industries, 72 shares of Borden, 300 shares of Lincoln National, and a $10,000 corporate bond of AA or Aa rating yielding 8½% maturing about 1981 or 1982 with a total not exceeding $55,000 be implemented. Seconded. Passed.

7. The committee to evaluate the annual meetings reported. Barr moved to receive the report to commend the committee for its work and to request the committee to evaluate the VPI meeting and then make recommendations for future meetings. Seconded. Passed.

8. Nominations for the Browning Award generally have been the responsibility of the Awards Committee with the final selection and presentation of the individual being done by the Board. Inasmuch as one of our members was chosen to receive the Browning Award this year, the AAEA will not present a selection for next year.

9. The use of metric terms in the AAEA publications was discussed and it was the consensus to continue with the current policy of accepting articles with either metric or nonmetric terms.

10. The issue of joining CAST was discussed. Kenneth Farrell and G. Edward Schuh were named to review the previous decisions and make recommendations.

11. A brief discussion was held on the impact of the 1976 Tax Reform Act on recruitment of economists for overseas work. The AAEA is prevented from taking policy positions and proposed to do no more than to call this issue to the attention of individual members.

12. Rasmussen reported for the American Agricultural Documentation Center and proposed $15,000 additional funding for the Center. The Board delayed any decision on additional funding until results of an evaluation of the activity are provided.

13. Hurt reported for the Alternative Publications Committee. Schuh moved the approval of the recommendations that (*a*) AAEA publish a Newsletter quarterly, totaling about 120 pages annually, to include miscellaneous items now published in the *Journal*, communications, surveys, special reports or articles, etc.; (*b*) the *Journal* not be divided into separate volumes for theory-methodology and applied studies but that the editor be encouraged to solicit quality articles in areas of strong demand and, if feasible, emphasize specific areas in certain issues; (*c*) the editor continue to commission special review articles for publication in the *Journal*; and (*d*) the practice of publishing abstracts of contributed papers in the *Journal* be continued with procedures being established for collecting complete copies of contributed and symposia papers and entering these through the American Agricultural Economics Documentation Center and University Microfilms, and that the *Journal* note that copies of complete papers would be available from above mentioned sources for a modest fee. Further, Schuh moved that the President appoint an ad hoc committee to make recommendations on implementation of these recommendations, that the Finance Committee develop its budget for 1979 on basis of the recommendations of this ad hoc committee, and that the Executive Board consider both the report of the ad hoc committee and the budget at the Blacksburg meeting, for implementation in 1979. Seconded. Passed. Rhodes, Baker, Hurt, and Redman were appointed to the committee.

Crowder moved to table the recommendation to appoint a special committee to study the feasibility of initiating a popularized-type publication while expanding the membership to include those outside of the Land Grant-government sphere. Seconded. Passed.

Farrell moved the recommendation that the proposed study of the use of microfilm and microfiche by the Professional Activities Committee be encouraged and supported and be transmitted to that committee. Seconded. Passed.

It was the consensus of the Board that the recommendation to appoint a special committee to study overall publication costs and alternative arrangements for publishing the *Journal* and other publishing activities of the Association be handled as need arises by the Finance Committee and the editor.

14. Sundquist reported on the progress of the committee on Management, Structure, Methods, and Procedures, and pointed out the need for job descriptions for all officers.

15. Tomek reported as editor. Redman was asked to follow up on the possibility of buying paper on contract in order to cope with the rise in paper cost.

Barr moved that AAEA follow the same practice in 1978 as was followed in 1973 for joint AAEA-CAES publication and print the 1978 proceedings issue for the Canadian Society at marginal cost plus cost of Canadian cover. Seconded. Passed.

16. Hildreth presented a draft of a Memorandum of Understanding between the AAEA and the Illinois State Employment Service for operation of the National Registry. Lane moved the Memorandum of Understanding between AAEA and the Illinois State Employment Service be approved in principle. Seconded. Passed.

17. After a discussion of the policies of the AAEA Executive Board as an addition to the bylaws, Lane moved that Section 2 of Article IV of the policies dealing with invitations to politicians to speak at the Association be rescinded. Seconded. Passed. Raup moved that the president be instructed to appoint three past-presidents as an ad hoc committee to draft a policy statement dealing with the issue of inviting politicians or political appointees to speak. Seconded. Passed. Lane moved that the policy statements as modified be approved and incorporated as a part of the bylaws. Seconded. Passed.

18. Stanton moved to accept the invitation of Iowa State University to host the AAEA in 1985. The Association will be celebrating the seventy-fifth anniversary of its founding which took place at Ames.

19. Stanton commented on the 1979 meeting to be

held on the campus of Washington State University.

20. The Board went into executive session to select the names to be presented to the Fellows Election Committee. Nine names were selected from the twenty-eight nominated.

21. Barr reviewed the 1978 budget with recommendations for adjustments. Barr moved its approval. Seconded. Passed.

22. Board adjourned at 6:00 p.m.

Respectfully submitted,
John C. Redman
Secretary-Treasurer

Minutes of the Executive Board Meeting, Blacksburg, Virginia

The meeting of the Executive Board was called to order by President R. J. Hildreth at 8:30 a.m., 5 August 1978.

Present: Voting Members:
Hildreth, Stanton, Raup, Farrell, Schuh, Coffey, Lane, Barr, Crowder
Members ex officio:
Redman, Rhodes, Colyer, Storey
Guest:
Chambliss

1. President Hildreth reviewed the agenda, indicating that only those committees with matters of special interest to present had been asked to be present.

2. Lane moved the approval of minutes of the Board meeting held in New York on 27 December 1977. Seconded. Passed.

3. Chambliss, chairman of Local Arrangements Committee, reported that everything was progressing nicely and that 1,100 members had preregistered, and based on previous on-site registrations the total should exceed 1,320 members.

4. Redman pointed out that some professional societies are having difficulties with the Internal Revenue Service, particularly in differential pricing of services to members and nonmembers and different classes of members.

5. Hildreth reported that he had signed (*a*) an extension of the grant from U.S. Department of Labor to 31 December 1978, (*b*) an amendment to the agreement with the University of Minnesota Press increasing the percentage of royalty to AAEA, (*c*) an extension of date whereby volume I of the survey of postwar literature may be purchased at a discount, and (*d*) a Memorandum of Agreement with the Illinois State Employment Service.

6. Redman, as secretary-treasurer, presented the CPA's annual audit and report to the Board. It supported the balance sheet and operating statement as prepared to be distributed at the general business meeting. Barr moved the approval of the CPA audit. Seconded. Passed.

Redman presented the following issues for Board consideration:

(*a*) Some possible legal questions in copyrighting the *AJAE* exist. It was recommended that a small ad hoc committee study the problems and procedures. The incoming president will appoint the committee.

(*b*) Reported for informational purposes on the landgrant institutions as censored by the AAUP.

(*c*) Reported that University Microfilms paid a royalty of $802.38 on $5,349.16 in sales and suggested that AAEA expand its publication activity in microform, particularly the contributed papers. Action was delayed until Stanton reported on his communication with Johnson Associates.

(*d*) Suggested that the idea of a foundation be explored or that a restricted account be established for gifts, grants, etc., which will permit donors to memorialize their desires or leave unrestricted income for AAEA projects.

(*e*) Referred to his letter of 23 February 1978 to the Board, concerning the problem of sending back issues of *AJAE* to delinquent members and those who failed to provide a current address. Stanton and Redman agreed to prepare a policy statement for the Board's consideration.

(*f*) Recommended that the Board consider the possibility of increasing the number of pages in the *AJAE* by some 150 to 200 pages annually as a top priority in expanded AAEA activities.

(*g*) Discussed some problems in handling the literature review orders.

7. Rhodes, as editor, presented his report to be given at the general business session. It was pointed out that the Heffernan printing contract expires at the end of 1979 and it was recommended a committee be appointed to review our contractual relationships and negotiate a new contract. Lane moved the approval of the editor's report. Seconded. Passed.

8. Stanton reported on his communication with the Johnson Associates to microfiche the *AJAE*. Since the AAEA apparently has had an agreement for several years with University Microfilms to publish the *AJAE* in microform, including microfiche, the Board directed the secretary-treasurer to obtain a copy of the specific agreement for further study and discussion.

9. Sundquist as chairman of the Committee on Management, Structure, Methods and Procedures, presented that committee's report. He reviewed the charge to the committee and procedures being used in its study and evaluation. The Board went into executive session with only voting members present to hear the report on one of the assignments, the evaluation of performance and work by the secretary-treasurer. The following was provided by Barr as minutes of that session: Barr moved that John Redman be commended for the major personal contribution he has made to the AAEA as

secretary-treasurer since January 1970, and subject to the annual evaluation preceding appointment prescribed in the bylaws that he be appointed annually by the Executive Board and continue in that office for an additional three-year term.

It was further moved that (*a*) the president of the Association appoint a three-person ad hoc committee to develop an operational position description for the office of secretary-treasurer at the earliest possible date, (*b*) this committee draw on the evaluation report prepared by Polopolus and Sundquist in developing a set of selected operational guidelines for the office of secretary-treasurer, and (*c*) the position description and operational guidelines be developed in consultation with the secretary-treasurer and used as a reference for his annual evaluation. Seconded. Passed.

Barr, in a separate motion moved that the Executive Board of the AAEA express their warmest appreciation to Mrs. Willetta Hager for her effective and responsible service in the office of the secretary-treasurer. Seconded. Passed.

10. Rhodes reported for the ad hoc committee to develop plans for a newsletter listing several options for Board consideration.

(*a*) Stanton moved that six issues of four to sixteen pages each be published each year starting January 1979. Seconded. Passed.

(*b*) It was agreed to retain the list of Institutional Members in the *AJAE*.

(*c*) Schuh moved that a list of obituaries with a short summary statement be listed in the *AJAE* with the longer prepared obituary being placed in the *Newsletter*.

(*d*) Crowder moved that in lieu of publishing full committee reports in the *Journal*, abstracts of the reports be published in the *Newsletter*. Seconded. Passed.

(*e*) It was agreed that the minutes of Board actions be kept in the *Journal* and expanded to provide adequate background of the issues presented in the reports to the Board.

(*f*) Stanton moved that the retiring president, Jim Hildreth, check into the nature of the archives being kept at the Wisconsin Historical Society. Seconded. Passed.

(*g*) It was agreed that the editor use his discretion in managing the "bulletin board" type of information carried in the *Newsletter*.

(*h*) Schuh moved that a viewpoint section be included as an option open for use by the editor in the *Newsletter*. Seconded. Passed.

(*i*) It was agreed that questionnaires be omitted from the *Newsletter*.

(*j*) Schuh moved that advertisements be included in the *Newsletter* and priced at the same rate currently charged for the *Journal*. Seconded. Passed.

(*k*) Coffey moved that (*i*) the AAEA accept paid job-vacancy advertisements in the *Newsletter*. In general, these would be a standard short ad of about 1/6 page or less for about $50.00. (*ii*) A report from the Professional Registries Committee on listings and activities be included regularly in the *Newsletter*. (*iii*) The Professional Registries Committee arrange to make available to job applicants, upon request, a list of new job vacancies whether or not they were listed on the Registry for Agricultural Economists. (*iv*) Information on job vacancy advertisements would be provided to RAE unless the advertiser objected. Seconded. Passed.

(*l*) Crowder moved that the *Newsletter* be sent to libraries and that with the third and fourth issues the editor enclose a letter, stating the nature and extent of the *Newsletter*, and asking each library to return the enclosed letter with an indication of whether or not the library wished to continue to receive the *Newsletter*. There will be no guarantee of delivery of issues and back copies will not be available. The policy with respect to mailing the *Newletter* to libraries will be reviewed at the 1979 summer meeting. Seconded. Passed.

(*m*) The Board discussed the recommendation that papers given at symposia and contributed papers sessions be sent to University Microfilms and the American Agricultural Economics Documentation Center and that the *AJAE* continue to publish the abstracts of contributed papers as well as titles of symposia, indicating the available sources. Lane moved that the papers in the contributed papers sessions be forwarded by the Association to University Microfilms, the possibility of their being submitted to the American Agricultural Economics Documentation Center be explored, and that the motion be implemented in 1978 if feasible. Seconded. Passed.

11. Barr reported for the Finance Committee. After reviewing the 1977 operating statement and the 1978 budget, Barr moved that the 1978 budget be adjusted to reflect more nearly the expected income and expenses. Seconded. Passed. Barr then reported on 1979 budget requests, strategies, and committee recommendations.

(*a*) The publication of the recommended *Newsletter* will add about $6,100 to the costs of the Association.

(*b*) The committee suggested that the Board initiate a dues increase of $2.00 next year for foreign members to reflect higher mailing costs. No action was taken.

(*c*) The committee recommended that a policy on reprints be developed to cope with the problems mentioned by Rhodes and Redman and that this should be considered at the winter meeting. Barr moved the approval. Seconded. Passed.

(*d*) The Finance Committee did not feel a submission fee for articles to the *Journal* would be appropriate at this time. No board action was taken.

(*e*) The committee felt that an evaluation of the current and potential use of the Literature Retrieval System by impartial observers and an assessment of the value to AAEA members needs to be completed before the additional $12,000 requested can be considered. In the interim, the committee recommended an appropriation at the current level of $15,000 per year. Schuh moved that the Board put a hold on further appropriation of funds for the Literature Retrieval System and that the Board undertake an evaluation of the current and potential use of the system and an assessment of the value to the members. Seconded. Passed.

(*f*) It was recommended that an ad hoc committee be appointed to develop a set of procedures to reduce costs (losses) to AAEA of publishing the postwar literature review. This was referred to Babb and his committee.

(*g*) The committee recommended $2,500 for travel grants to be awarded to young American AAEA members for the 1979 IAAE meetings in Banff. The item will be subject to approval with the 1979 budget.

(*h*) The committee recommended the purchase of a $20,000 corporate bond with a high rating paying 9%. Barr moved this recommendation be implemented by the secretary-treasurer within ten days. Seconded. Passed.

Crowder suggested that the portfolio regularly provide an analysis of each of the equity issues, and if action is needed the President was requested to poll the Board.

(*i*) The committee will continue to explore and obtain possible bids on various types of liability insurance coverage for the Association.

(*j*) The Finance Committee supported the proposal by the Professional Activities Committee asking the Finance Committee to review the dues structure on an annual basis and to recommend a course of action. The suggestion was accepted.

12. Ball reported as chairman of the Awards Committee.

(*a*) A special certificate was prepared for presentation at the 1978 annual meeting to the winner of the 1977 Browning Award, Earl O. Heady.

(*b*) A suggestion was made for joint sponsorship of an award by the AAEA and the American Society of Agronomy. The Awards Committee recommended no action be taken.

(*c*) The committee evaluated the proposal for more interdisciplinary work. A suggestion was made that the editor commission a paper on an interdisciplinary topic. No action was taken.

(*d*) The committee recommended that, beginning with the 1978 Proceedings issue, the past and current winners of the Publication of Enduring Quality Award be featured in order to give the award visibility and increased interest in both the nominating process and the award itself. Raup moved the approval of the recommendation. Seconded. Failed.

(*e*) The committee recommended that the number of possible awards for publications of enduring quality be increased from one to two a year—one being for the moving fifteen-year period now used twenty-five to ten years prior to year of award) and the other for publication dated more than twenty-five years earlier. No action was taken.

(*f*) The committee recommended that the description of the award for publication of enduring quality appearing in the *AJAE* should state that nominations of one year, not rejected on grounds of not being of enduring quality, will be cumulated into a master list and considered in subsequent years along with any new entries. Schuh moved the approval. Seconded. Passed.

(*g*) It was recommended that the *AJAE* state succinctly that the award for enduring quality is to recognize a publication for its contribution to the profession and that competition is among publications rather than people. It was consensus of the Board that the wording should be changed accordingly.

(*h*) The committee encountered an issue in the intent of the Outstanding Degree Program Awards. Is the intent to recognize outstanding graduate student research on agricultural economic topics regardless of department or institution or to recognize outstanding research by graduate students in agricultural economics? It recommended that a graduate student, to be eligible, must be pursuing the degree in agricultural economics or have a major in or be pursuing a degree in economics with the thesis on an agricultural economics topic. Lane agreed to develop a new statement on this issue for inclusion in the bylaws.

(*i*) The Board commended Gordon Ball for two years of devoted service as Chairman of the Awards Committee.

13. Riley reported as chairman of International Committee, citing as its major accomplishment the development of a proposal and the obtaining of AID funding for a project on needs and strategies for improving training of agricultural economists from less developed countries for work in agricultural economics in their own countries and in international work. The primary activity for next year will be to carry out a study of training needs and to arrange for related follow up through workshops and publications. Riley requested general support of AAEA and was complimented for his work.

14. Barkley, as chairman of Professional Activities Committee, reported and recommended the following:

(*a*) That the AAEA continue to pursue the possibility of a project funded by National Science Foundation. No action was taken.

(*b*) That the Resident Instruction Committee be asked to develop a prototype symposium or series of symposia to assist in upgrading the skills of teachers of agricultural economics. These symposia should be self-financing but should be maintained under the auspices of the Association. The first symposium should be available within two years and, if possible, should be held on the campus of a non-land-grant school. Farrell moved that the recommendation be implemented. Seconded. Passed.

(*c*) That the program of the 1979 AAEA meetings include an invited papers session devoted to the supply and demand of agricultural economists. The Board and the president will consider the recommendation in developing the program.

(*d*) That the AAEA adopt the practice of using small but frequent increases in dues. This was referred to the Finance Committee for consideration in financial planning.

(*e*) That an ad hoc committee be established to inquire into the feasibility of AAEA developing a selective set of insurance programs for its members. Such programs should acknowledge the special needs of young members and members who are nearing retirement. It is suggested that one member of the Professional Activities Committee be asked to sit with the ad hoc group. It was the consensus that the president will appoint a three-person committee.

(*f*) That AAEA form a Program Committee invested with the power and responsibility of developing the program for the annual meeting. This committee should plan sufficiently far in advance so major aspects of the program can be published in the January issue of the *Newsletter*. No action was taken because the recommendation is being implemented.

(*g*) Coffey moved that the Professional Activities Committee be requested to study the methods, procedures, criteria, etc. by which it will evaluate requests for workshops and report no later than the January Board meeting. Seconded. Passed.

15. After a discussion on requests for AAEA to cosponsor or endorse meetings, seminars, etc., Coffey moved the following be included as a section (No. 5) of Policies of AAEA Board: "If an activity is approved by the Board, a member of the Board along with other members of the Association, as needed and appropriate, will be designated as liaison with the activity to implement the Board's decision and monitor Board policy. Proposals may also be initiated by other committees, e.g., International Committee, Resident Instruction Committee, etc., referred to them or referred to Professional Activities Committee from another Committee." Seconded. Passed.

16. Boyne and Mather reported for the Professional Registries and Employment Committee and reviewed the activities during the year. The committee worked with Hildreth in developing a Memorandum of Agreement with the Illinois State Employment Service to become effective on 16 February 1978.

Lane moved that the changes in the Memorandum of Agreement with the Illinois State Employment Service be accepted in principle with the president authorized to negotiate changes in detail. The specific changes noted were that the words "and services" be added to Item C under the list of items the Illinois State Employment Service is to provide, so that it will read, "Telephone, postage, miscellaneous supplies and services." To Item C under the list of items the American Agricultural Economics Association is to provide, the words "purchase or lease of supporting supplies and transportation charges for materials" are to be added so that it will read, "Travel expenses for Employment Service staff attending annual conventions, purchase or lease of supporting supplies, and transportation charges for materials to provide on-site placement service."

The committee recommended that future *Handbook-Directory* issues be prepared with camera-ready copies from the Registry for Agricultural Economists (RAE). This item has been under study by the committee at the request of the Board. Farrell moved that the Board accept in principle the recommendation of the Professional Registry and Employment Committee that future *Handbook-Directory* issues be prepared with camera-ready copy utilizing the RAE data base and, as appropriate, Association membership information, and that the Professional Registry and Employment Committee and the secretary-treasurer develop procedures to implement this action. Seconded. Passed.

17. Stanton and Redman presented a set of guidelines on dues and orders for back issues of the *Journal* and *Newsletter*.

(*a*) Annual dues for AAEA members cover the calendar year, 1 January–31 December. (*b*) If annual dues are paid by 1 April, all issues of the *Journal* and *Newsletter* for that year will be mailed to the member. Membership by 1 April certifies eligibility for voting in Association elections. (*c*) Annual dues received after 1 April entitles the member to receive all subsequent issues of the *Journal* and the *Newsletter*. Back issues of the *Journal* for the year will be supplied only on request and for an additional fee of $5 to cover cost of postage and handling. (*d*) Members who do not provide the secretary-treasurer with a change of address by the first of the month prior to the publication date may obtain missing issues at $5.00 to cover the extra cost of postage and handling.

Lane moved the approval and that these guidelines be included in the policy section. Seconded. Passed.

18. Lane, in an effort to clarify the issue of whether the Outstanding Degree Program Awards should emphasize the thesis or the program, moved that the emphasis should be on the thesis. Seconded. No official vote was taken but a straw vote favored the thesis. Lane volunteered to work with the chairman of the Awards Committee to develop a suitable statement for the next Board meeting.

19. Edwards reported on contributed papers and indicated that about 200 papers were submitted. He recommended that a checklist for the member be developed and that more members be added to the committee to handle with the review process and final selection.

20. Rasmussen reported for the Literature Re-

trieval Committee. Evaluation of the quality of the file and its use continues to be an issue of concern to the Board members.

21. Herr reported for the ad hoc committee on non-land-grant college member services.

22. Other committee reports submitted for Board information included Extension Affairs, Economic Statistics, Membership, Resident Instruction, Tellers, Industry, Survey of Postwar Literature, and Agricultural Census Advisory Committee.

23. Schuh reported on impressions of the National Bureau of Economic Research.

24. Farrell reported on the proposal to consider again the possibility of joining Council on Agricultural Science and Technology (CAST). Schuh moved that positive action be taken to involve the membership in the decision to join CAST. Seconded. Passed. The president was directed to form a committee to develop a statement reviewing the advantages and disadvantages of joining CAST so that the members can make an informed decision.

25. Farrell reported on Board Policy Concerning Invitations to Political Officials. After discussion of the report, Farrell moved the adoption of the following statement of policy: "No person holding or seeking an elective national or state political office shall be invited to speak at Association-sponsored meetings during years of national (congressional or presidential) or state (gubernatorial) political campaigns, respectively. In extending invitations to persons holding appointive political offices, the Executive Board should exercise discretion to insure professional propriety, integrity, and objectivity of the Association in keeping with Assocation bylaws which prohibit it from taking positions on national policy issues." Seconded. Passed with two (2) no votes.

26. Redman presented a report on the wording of the page charge statement, pointing out some possible risks involved in maintaining the second class mailing permit associated with some alternative statements. Lane moved that the following wording be approved: "Major support for this *Journal* is provided by page charges of $40 per printed page, or fraction thereof, payable by the supporting institution or granting agency. Payment does not affect acceptance, scheduling, or form of publication. Instructions for making payment are provided with galley proofs." Seconded. Passed

27. Stanton reported that the Kellogg Foundation will fund an AAEA lectureship at $2,500 to celebrate its fiftieth anniversary. He also reviewed the program at the Allied Social Science meetings in Chicago, and announced a program meeting of the Board in November and a regular Board meeting in January 1979.

28. Crowder reported for the Advisory Committee on Fellows.

29. Hildreth reviewed some possible sites for future meetings of AAEA. Hildreth volunteered to work with the secretary-treasurer in evaluating and recommending some possible locations for annual meetings.

30. Barr moved the approval of the budget for 1979 as amended to include items previously voted. Seconded. Passed.

Meeting adjourned 5:30 p.m.

Respectfully submitted,
John C. Redman
Secretary-Treasurer

Minutes of the Annual Business Meeting, Blacksburg, Virginia

The 67th annual meeting was called to order by President R. J. Hildreth on 8 August 1978 at 3:30 p.m.

1. Hildreth presented for approval the minutes of the annual business meeting held at San Diego, California, 2 August 1977, as published in the proceedings issue of the *Journal*. Motion was duly made. Seconded. Passed.

2. Hildreth announced officially the results of the election of officers. Richard A. King was elected president-elect, and Thomas Brown and John Hopkin were elected directors.

3. In his Presidential Report, Hildreth reviewed the activities of AAEA during the year: (*a*) Indicated that the all-time high membership, good financial position, and record attendance at this meeting were the results of many people during the present and past years, especially those who serve on committees. (*b*) Pointed out that the major activity of the Association is the publication of the *Journal* which with the holding of the annual meeting provided an outstanding service to the profession and society. (*c*) Signed a Memorandum of Agreement between AAEA and the Illinois State Employment Service with the ISES providing most of the funding and support for the operation of the Registry. (*d*) Announced that a *Newsletter* will be published on a regular basis, six issues per year, beginning in January 1979. (*e*) Contributed papers from the annual meeting will be forwarded to University Microfilms, Ann Arbor, Michigan, and the American Agricultural Economics Documentation Center. (*f*) The International Committee developed a proposal and obtained AID funding for a project entitled, "Needs and Strategies for Improving Training of Agricultural Economists for Work in International Development." (*g*) It is expected that volume III, the final volume, of the series of postwar literature review, will be in press by end of this year. (*h*) The Economic Statistics Committee was involved in planning and sponsoring an Agricultural and Rural Data Workshop. It has three task forces operating—one on economic value of statistical information, one on the measurement of agricultural productivity, and one on agricultural outlook. (*i*) The American Agricultural Economics Documentation Center is a joint effort between AAEA and

ESCS of USDA and continues to improve its ability to serve. (*j*) Mentioned a number of activities which dealt largely with internal issues of the AAEA, such as studying the management, structure methods and procedures, improved budgetary preparation and control as well as decision making concerning the portfolio, preparation of a brochure by the Resident Instruction Committee for potential undergraduates in agricultural economics. (*k*) The Board had conducted an evaluation of the Office of Secretary-Treasurer and based on the evaluation, the Board extended an offer to John Redman to continue as secretary-treasurer for a series of three one-year terms with thanks to John and the University of Kentucky for past and future service. (*l*) Expressed thanks for the opportunity to serve as president of AAEA for 1977–78 and hoped that the Association and the profession has been advanced.

4. Redman presented the Secretary-Treasurer's Report for fiscal year 1 January 1977 through 31 December 1977. Redman also presented a report on AAEA investments for 1977. Motion was made to receive the report. Seconded. Passed.

5. Hildreth presented the report of the certified public accountant on the financial condition of the AAEA and announced that a copy would be on file for anyone desiring to examine it. Motion was made to accept the report. Seconded. Passed.

6. Barr reported for informational purposes some budgetary items, the estimated income, expenses, and other items such as *Newsletter* costs, grant, etc.

7. Rhodes reported as editor of the *Journal*. The report was accepted.

8. Hildreth presented the schedule of future meetings. The 1979 meeting will be held on the campus of Washington State University on 29 July–1 August and the 1980 meeting will be at the University of Illinois on 27–30 July.

9. No old business was noted.

10. King presented a resolution expressing appreciation to Virginia Polytechnic Institute and State University for hosting an outstanding meeting. An enthusiastic round of applause expressed approval.

11. Hildreth expressed to the Executive Board and particularly to the retiring Board members, Wallace Barr and Philip Raup, and Past-President Kenneth Farrell for their assistance during his term as president and turned the chair over to Bernard F. Stanton who became president.

12. Stanton announced the Nominating Committee with R. J. Hildreth as chairman.

13. Meeting adjourned at 4:45 p.m.

Respectfully submitted,
John C. Redman
Secretary-Treasurer

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